RINGWALT

DEVELOPMENT OF TRANSPORTATION SYSTEMS IN THE UNITED STATES

CONESTOGA WAGON TRANSPORTATION.

FROM A PAINTING BY N. H. TROTTER FOR H. H. HOUSTON.

CANAL MOVEMENTS NEAR ALLEGHENY PORTAGE RAILROAD.

FROM A PAINTINO BY N. H. TROTTER FOR H. H. HOUSTON.

Development

of

Transportation Systems

in the United States

Comprising a comprehensive description of the leading features of advancement, from the colonial era to the present time, in water channels, roads, turnpikes, canals, railways, vessels, vehicles, cars and locomotives; the cost of transportation at various periods and places, by the different methods; the financial, engineering, mechanical, governmental and popular questions that have arisen; and notable incidents in railway history, construction and operation.

With Illustrations of Hundreds of Typical Objects

BY

J. L. RINGWALT

EDITOR OF THE RAILWAY WORLD

PHILADELPHIA
PUBLISHED BY THE AUTHOR
RAILWAY WORLD OFFICE, 420 LIBRARY STREET
1888

JOHNSON REPRINT CORPORATION
111 Fifth Avenue, New York, N.Y. 10003

JOHNSON REPRINT COMPANY LTD.
Berkeley Square House, London, W. 1

Reprinted from a copy in the collections of
The New York Public Library
Astor, Lenox and Tilden Foundations

History of American Economy: Studies and Materials for Study

A series of reprints of the important studies
and source books relating to the growth of the
American economic system.

General Editor: William N. Parker

First reprinting, 1966, Johnson Reprint Corporation
Printed in the United States of America

INTRODUCTION

TRANSPORTATION is the act of carrying persons or property from one place to another. The extent to which convenient facilities for such movements are furnished affects, in a large degree, the physical welfare of every human being.

All progressive nations, therefore, desire to secure the advantages derived from superior systems of transportation.

In accomplishing that object expensive and complicated labors must be performed.

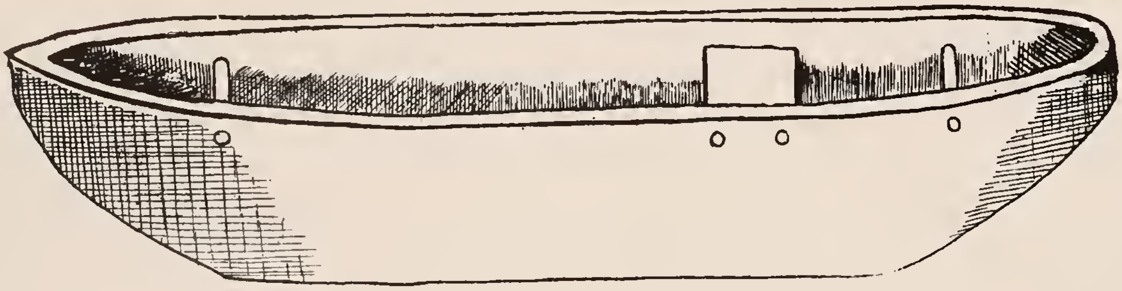
This necessity arises from the fact that while transportation may be conducted on land or water, the best results are not attainable unless large outlays are made for the improvement of roads and water-ways.

The conditions under which the sums necessary to perfect these improvements are procured, and the characteristics of the improvements existing at different periods and in different sections, are so diversified that grave questions have arisen in regard to the selection of methods.

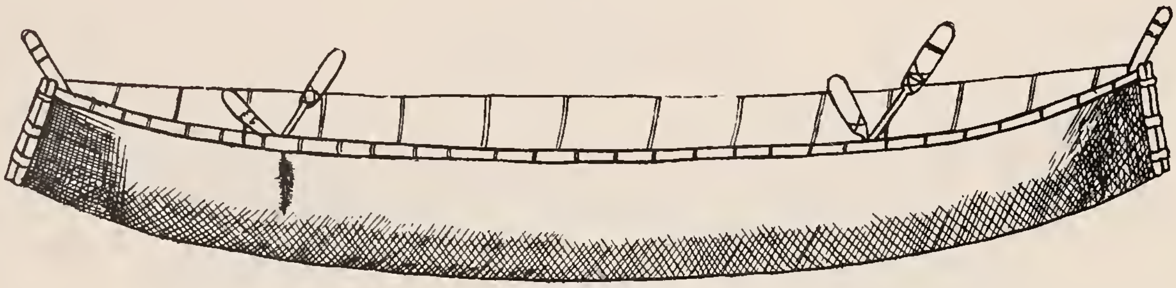
All improvements substantially hinge on advances in the condition of the land- or water-ways used, the vehicles or vessels employed, and the nature of the propelling or motive power adopted. This country has been prolific in variety of experiments tried, in the rapidity of beneficial progress, and in useful results achieved.

As the entire system is still in a transition state, and as every important expedient hitherto adopted is in practical use in some portion of the broad national domain, any veritable account of the past may furnish instructive illustrations of changes now progressing, and suggestions for the future guidance of individuals, corporations, communities, and public authorities.

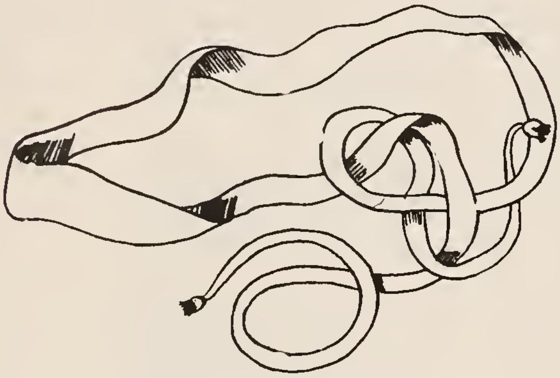
It is the object of this work to explain leading characteristics of the successive steps by which the canoe has been supplanted by the steamer, the trail by the T-rail, the pack-horse by the locomotive; and to furnish a comprehensive compendium of instructive transportation literature accumulated while railway mileage was expanding to its present huge proportions.



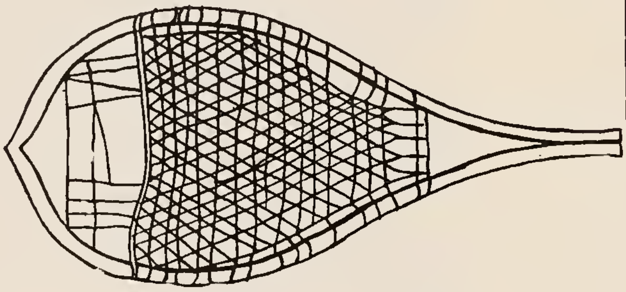
Dug-out.



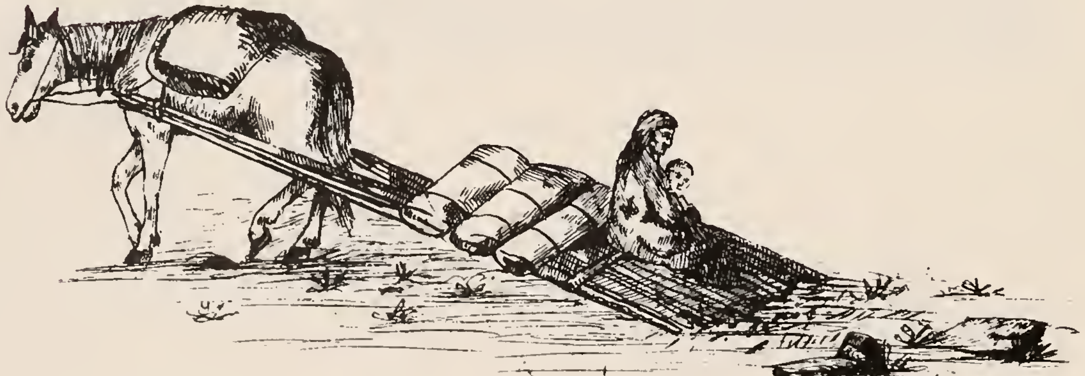
Bark Canoe.



Burden Strap.



Snow-shoe.



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INDIAN SYSTEM OF TRANSPORTATION.

INDIAN traditions, and the best light attainable in regard to their antecedents, indicate that within a comparatively brief period before the discovery of America by Columbus their ancestors had journeyed from the Pacific to the Atlantic coast, or over a large portion of the intermediate distance, thus acquiring a familiarity with the topographical features of the continent; and their continuance in the hunter state, and frequent wars, compelled such numerous movements that they were necessarily a migratory race. Even those who built structures, which they usually occupied during a portion of each year, sent forth hunting parties, who roamed over large districts or organized expeditions by which favorite fishing grounds were visited during appropriate seasons. The savages of the plains followed the buffalo, which furnished their chief subsistence, in the northward movements he made in the spring and his southward movements in the autumn of each year. A rough estimate of the extent of the routes occasionally traversed by the warriors of some of the tribes may be based on the statement made in reference to the Six Nations, by De Witt Clinton, the famous Governor of New York. In an oration, delivered in 1811, he said that "their military excursions extended as far north as the Hudson bay. The Mississippi did not form their western limits. Their power was felt in the most southern and eastern extremities of the United States. . . . For nearly a century and a half they maintained a war against the French possessions in Louisiana and Canada."

Whether the warlike operations in which the savages frequently engaged were successful or unsuccessful, they necessitated long journeys. The penalty of a terrible defeat was the banishment of the survivors to a remote region. One of the most important aids to victory was the ability to march over a wide expanse of territory so secretly that the enemy to be assailed was surprised. When peace prevailed, long and frequent journeys, in some of which entire tribes participated, were occasionally necessitated by the movements of game and fish, sometimes by the desire to gratify a savage taste for change of scene analogous to the impulse which now sends many dwellers in towns and cities to country and seaside resorts every summer, and sometimes by the wish to witness contests or combats between representatives of friendly but rival tribes, or to participate in revelries, which the savages were as ready to invent and as anxious to enjoy as their civilized successors.

Such tastes, necessities, and requirements necessarily made the Indians pre-eminently a traveling people. One of the first effects of civilization seems to be of a directly opposite character. Giving mankind fixed homes, and furnishing occupations followed at established farms or workshops, has a tendency to check freedom of movement, until some persons become almost as deeply rooted as surrounding forests in the immediate vicinity of the soil where they were born and have lived. Savage life, on the contrary, abounds with incitements to migrations, analogous to those made by birds, beasts, and fish.

Under these conditions, the aborigines of the United States acquired great expertness in moving between distant points. Their readiness to plunge into an impenetrable wilderness, and their ability to serve as proficient guides of expeditions which explored long distances, are explained by the severe training imposed by hunting over large districts, and by going on the war-path to attack remote enemies. Few white men have ever equaled them in the knowledge of what might be termed natural geography, or the skill to observe the signs by which an obscure but direct and available pathway may be found between any two points.

It is part of our modern history that Cherokee Indians of Georgia were the first to discover the existence of gold mines in Colorado. Records abound in which the services of the aborigines to parties of inland explorers, surveyors of proposed new roads or routes, and to soldiers, is noted, but due recognition of their talent as pathfinders has often been neglected.

Despite all modern improvements many of the land and water routes which now furnish favorite avenues of internal commerce, were traversed for centuries by savage predecessors, their trails carving out lines of our common roads, turnpikes, and railways, and their light canoes being supplanted on the rivers and lakes by our steamboats.

CANOES—THE DUG-OUT, BIRCH-BARK, AND CORACLE.

The abundance and length of rivers, lakes, and other navigable waters made the canoe an adjunct of incalculable importance to the savages. In it they could make long journeys in almost every direction, by occasionally transporting their frail barks overland around falls or rapids, or between distinct water systems. The amateur voyages sometimes made at the present day in paper boats, such as descending the Delaware, Missouri, or Mississippi, from their head waters to their mouths, found their counterparts in many realistic movements of the aborigines. The canoe was to nearly all the tribes what the horse is to the Arab. The scope for water wanderings, under a system which provides for the voyageur carrying his boat on his back when such a resort is necessary or desirable, is practically illimitable in the United States. The entire country from north to south, and many of its districts, can be traversed by following the course of the Mississippi and the Missouri, and the continent can be crossed, from east to west, by following the line of the St. Lawrence, the great lakes, some of their north-western tributaries, the upper Missouri, and the Columbia and its tributaries, by intermingling a few comparatively short overland marches with many miles of continuous sailing. Similar facilities exist within each important section, and the Indians availed themselves very freely of these local or secondary channels, because they could commonly be used by the members of the respective tribes within the limits of their rude territorial divisions, in comparative safety.

A marked feature of the policy of the Iroquois, which was probably adopted by many other natives, was the avoidance of river boundaries. If a tribe had rights on a river, they were of equal validity on both its banks. One band might thus monopolize the Delaware, another the Susquehanna, another the Hudson, and another portions of the Ohio, until every important natural channel fell under exclusive ownership. The general course of pioneer settlement among many nations has been on banks of rivers, and the custom of converting them into boundaries between distinct governments was not followed here until colonies and states were marked out by old-world methods; and the savages, by avoiding water lines, or substituting for them a wide area of hunting grounds, materially increased their chances of combining the successful pursuit of fish and game with an avoidance of unnecessary conflicts, and the power of speedily concentrating their scattered warriors and families. By living on both sides of a river, and near its banks, they could all reach a common point in canoes at short notice.

The size of the canoe varied with the facilities for procuring materials and the uses to which it was to be applied. The bark canoes of the Iroquois were from twelve feet in length, with sufficient capacity to carry two men, to forty feet, with capacity for thirty men. One writer speaks of a canoe capable of carrying fifty men. The standard which seems to have been most closely approached by tribes that built canoes intended for participation in comparatively extended savage military or commercial movements was two tons. Birch bark was preferred as the principal material, because it was not likely to warp, but some of the tribes were compelled to make bark canoes out of less desirable substances, because birch trees did not grow within their territories. Other tribes usually made canoes by hollowing out the trunks of trees, and others by stretching the skins of animals over a light wicker-frame work.

During the fourth voyage of Columbus he landed on one of the West Indies, at which he was visited by an Indian, who used a trading canoe eight feet wide, but formed of a single tree. It was propelled by twenty-five rowers. The earliest explorers of the New England coast saw Indians sailing in canoes.

The lightness of the birch canoes made them specially desirable to all the tribes accustomed to expeditions which involved the necessity of frequent overland transfers from one river to another, or between points where rapids or falls created insurmountable obstacles to continuous river navigation. Longfellow says, of Hiawatha's birch canoe, that—

——the forest's life was in it,
All its mystery and its magic,
All the lightness of the birch-tree,
All the toughness of the cedar,
All the larch's supple sinews;
And it floated on the river
Like a yellow leaf in autumn,
Like a yellow water lily.

Father Charlevoix, who made a very extended tour over the French possessions in North America, and leading American water courses, including the lakes, the approaches from them to the Mississippi, and the Mississippi itself, during the early portion of the eighteenth century, gives the following description of the birch canoe, which he says was then used by the French and nearly all the savages he visited except the Iroquois: "They lay the bark, which is very thick, on flat and very thin ribs made of cedar; these ribs are confined their whole length by small cross-bars, which separate the seats of the canoe; two main pieces of the same wood, to which these little bars are sewed, strengthen the whole machine. Between the ribs and the bark they thrust little pieces of cedar which are thinner still than the ribs, and which help to strengthen the canoe, the two ends of which rise by degrees, and insensibly end in sharp points that turn inwards. These two ends are exactly alike; so that to change their course, and turn back, the canoe men need only change their heads. He who is behind steers with his oar, working continually; and the greatest occupation of him who is forward, is to take care that the canoe touches nothing to burst it. They sit or kneel on the bottom, and their oars are paddles of five or six feet long, commonly of maple; but when they go against a current that is pretty strong, they must use a pole and stand upright. One must have a good deal of practice to preserve a balance in this exercise, for nothing is lighter, and of consequence easier to overset, than these canoes; the greatest of which, with their loading, does not draw more than a half a foot of water. The bark of which these canoes are made, as well as the ribs and the bars, are sewed with the roots of fir, which are more pliable, and dry much less, than the ozier. All the seams are gummed (or pitched) within and without, but they must be viewed every day, to see that the gum is not peeled off. The largest canoes carry twelve men, two upon a seat, and four thousand pounds weight. Of all the savages the most skillful of canoes are the Outaouais; and in general the Algonquin nations succeed herein better than the Hurons. Few French as yet can make them even tolerably; but to guide them, they are at least as safe as the savages of the country; and they practice this exercise from their childhood. All the canoes, even the smallest, carry a sail, and with a good wind can make twenty leagues in a day. Without sails they must be good canoe men to make twelve leagues in a dead water."

Father Charlevoix does not say whether this practice of using sails was suggested by the French or was of savage origin. A singular instance of the readiness of the Indians to avail themselves of such appliances is given in Catlin's description of the movements of the Sacs and Foxes on the Mississippi and adjacent rivers. He says: "I was often amused at their freaks in their canoes, whilst traveling; and I was induced to make a sketch of one which I frequently noticed, that of sailing with the aid of their blankets, which the men carry; and when the wind is fair, stand in the bow of the canoe and hold by two corners, with the other two under the foot or tied to the leg; while the women sit in the other end of the canoe, and steer it with their paddles."

In describing the manners, customs, and condition of the north-western Indians when he visited them, which was before any permanent and extensive settlements of white men had been established in the regions they occupied, Catlin says "the bark canoe of the Chippeways (whose main subsistence was then derived from fishing, and who were, therefore, specially proficient in the art of constructing canoes) is, perhaps, the most beautiful and light model of all the water craft that ever were invented. They are generally made complete with the rind of one birch tree, and so ingeniously shaped and sewed together, with roots of the tamarack, which they call *wat-taps*, that they are water-tight, and ride upon the water as light as a cork. They gracefully lean and dodge about, under the skillful balance of an Indian or the ugliest squaw; but like everything wild, are timid and treacherous under the guidance of a white man; and if he be not an experienced equilibrist, he is sure to get two or three times soused, in his first endeavors at familiar acquaintance with them."

Of the canoes covered with skins, used by a number of the western tribes, John D. Hunter, who lived among them as a captive from infancy until he was nineteen years of age, says they "are made promiscuously by either men or women, and sometimes conjointly by both, according to the exigency for which they are wanted. The skeletons or frames are made of osiers or flexible poles, lashed together with bark or some other materials, and are covered generally with the skins of the buffalo, sewed together, and to the frame with the sinews of the deer. They vary in size considerably, according to the service for which they are wanted. Sometimes a single skin covers one, and at others a half dozen are required. The hair is left on the outside. It, however, soon wears off, when the boat moves rapidly through the water, and is easily managed. The Indians smoke, oil, and preserve them with great care, which makes them very durable. When traveling, they often remove them to the land, invert, and use them for shelters against the rain. Being exceedingly light, they are carried without inconvenience over the longest portages."

Of the Mandans, of the upper Missouri, Catlin states that they used skin canoes "which are made almost round, like a tub, by straining a buffalo's skin over a frame of wicker work, made of willow or other boughs. The woman, in paddling these awkward tubs, stands in the bow, and makes the stroke with the paddle by reaching it forward in the water, and drawing it to her, by which means she pulls the canoe along with some considerable speed. These very curious and rudely constructed canoes are made in the form of the Welsh coracle."

Washington Irving's Astoria, in describing a trip of fur traders, made in the early part of the present century across the Rocky mountains, contains the following reference to a custom of the Arickaras or Rickarees, a tribe then noted for the number of their horses:—

While they (the fur-trading party) were regarding the village, they beheld a singular fleet coming down the river. It consisted of a number of canoes, each made of a single buffalo hide stretched on sticks, so as to form a kind of circular trough. Each one was navigated by a single squaw, who knelt in the bottom and paddled, towing after her frail bark a bundle of floating wood, intended for firing. This kind of canoe is in frequent use among the Indians. The buffalo hide being readily made up into a bundle, and transported on horseback, it is very serviceable in conveying baggage across the rivers.

Catlin says of the log canoe, or "dug-out," as it is often called in the west, of the Sioux and other eastern as well as western tribes, that it is dug out of a solid log with great labor by tribes that had but few tools to work with. Another writer, in describing the method of constructing the dug-out, says that by the help of fire and his stone axe the Indian "would bring down a giant tree from the forest, and sever a section of the trunk of desired length, with regard to proportions of width and depth. This solid butt he would then split with wedges, and by burning and gouging would hollow it out, reducing the sides and bottom to the utmost thinness consistent with buoyancy and security."

Some of the captives who were compelled to accompany Indians to distant homes speak of the readiness with which they constructed log rafts when deep waters were to be crossed. There are accounts of canoes being found at desirable places for crossing rivers or lakes, which were presumably kept at those points for general accommodation. Among some of the important tribes there were considerable variations in the mode of constructing canoes, arising from the nature of the exigencies to which they were subjected, and the character of the materials available at given periods. There are extant specimens of savage war canoes in some of the museums, which indicate, by their magnitude and the care taken in their construction and decoration, that when the energies of an entire band were concentrated on these structures they could in some instances be rendered as formidable and capacious in the eyes of their builders as iron-plated war steamers seem to be from the standpoint of modern civilization.

On the north Atlantic coast canoes were built by the Indians of both the birch-bark and dug-out types. In Maine they were usually made of the bark of birch trees, sewed on ribs of ash wood, and so light that a savage could readily carry one, capable of holding eight or ten persons, on his head. Of canoes made in Massachusetts, Wood, writing in 1634, says: "Their cannows be made either of pine trees, which, before they were acquainted with Ennglish tooles, they burned hollow, scraping them smooth with clam shels and oyster shels, cutting their outsides with stone hatchets. These boats be not above a foot and a halfe or two feet wide and twenty foote long. Their other cannows be made of thinne birch rines, close ribbed on the inside with broad, thinne hoopes, like the hoopes of a tub. These are made very light. A man may carry one of them a mile, being made purposely to carry from river to river and from bay to bay to shorten land passages. In these cockling fly-boats, wherein an Englishman can scarce sit without a fearfull tottering, they will venture to sea, where one English shallop dare not beare a knot of sayle, scudding over the overgrowne waves as fast as a wind-driven ship, being driven by their paddles. Being much like battledores, if a cross wave (as is seldom) turne her keel upside down, they by swimming free her, and scramble into her againe."

Of canoe building in Rhode Island, Roger Williams says: "I have seen a native go into the woods with his hatchet, carrying only a basket of corn with him, and stones to strike fire. When he had felled his tree, being a chestnut, he made a little house or shed of the bark of it. He puts fire, and follows the burning of it in the midst in many places. His corn he boils, and hath the brook by him, and sometimes angles for a little fish. But so he continues burning and hewing until he hath within ten or twelve days, lying there at his work alone, finished, and, getting hands, launched his boat, with which afterwards he ventures out to fish in the ocean."

George E. Ellis, in the Red and the White Man, says that "the Indian canoe seemed to need an Indian for its most facile use and its safest guidance. The best position for the occupant was to lie flat on his back if he trusted to floating, or to rest still on bended knees if he plied the single paddle with strokes on either side. All uneasy, restless motions, all jerks and sidelings were at the risk of passenger, canoe, and freight. Count Frontenac, when first, as Governor of Canada for Louis XIV, he began his experience as a voyageur with the natives, expressed in strong terms his disgust at the cramped and listless position to which he was confined in the birch canoe; and the Jesuit missionaries, the most patient and heroic of all Europeans, as they met every cross and hardship, were very slowly wonted to it. They gave us many piteous narrative touches of the constant risks and the need of steady eye and of a stiff uniformity of position in the buoyant but ticklish vehicle of transport. When needed they had in it their own precious sacramental vessels, requiring an ever nervous watchfulness against disaster. Till the passengers had learned to adapt themselves to the exacting conditions, their timidity and anxiety furnished a constant source of ridicule and banter to their native pilots. The merriment was loud and unsympathizing when the passenger tipped himself into the waters, still or foaming, unless at the time he swamped the canoe with a valuable cargo."

LAND MOVEMENTS OF THE INDIANS.

Aside from their skill in making and managing canoes, the aborigines had comparatively few contrivances for facilitating transportation. They were not wholly destitute of aids for land movements, however. The burden straps formed an important adjunct for those who were compelled to carry heavy loads from point to point, or over portages. The burden strap was commonly worn around the forehead and lashed to a litter borne on the back. It was usually about fifteen feet in length and braided into a belt in the centre, three or four inches wide.

The Indian system of carrying burdens upon their backs or dragging them is so primitive and wearisome that of all methods of transportation it combines the greatest amount of human effort with the least practical effect. It was, however, very extensively used, in moving fuel or food, over short distances and in journeys over portages or the connecting links between two water courses or channels. The fact that for many purposes no other method was available formed one of the most serious of the numerous privations and discomforts of savage life.

CARRYING DISABLED PERSONS.

There was an Indian method of carrying disabled persons overland, but it was so cumbersome that it could only be employed in cases where the motive for extraordinary exertion was unusually strong. When Champlain helped the Hurons in an attack upon the Iroquois, soon after 1600, and was wounded and unable to walk, he was placed by them in a basket of wicker work, and so doubled up and fastened with cords that he could scarcely move. Thus bound he was carried by the Indians, on their backs, for several days.

SLEDGES AND SNOW-SHOES.

In winter primitive sledges helped to solve some transportation problems which perplexed the savages. Dogs were used in some sections. The northern tribes showed much dexterity in the use of the snow-shoe as an instrument for facilitating winter journeys. Morgan described the snow-shoe of the Iroquois as follows: "The snow-shoe is nearly three feet in length, by about sixteen inches in width. A rim of hickory, bent round with an arching front, and brought to a point at the heel, constituted the frame, with the addition of cross pieces to determine its spread. Within the area, with the exception of an opening for the toe, was woven a network of deer-strings, with interstices about an inch square. The ball of the foot was lashed at the edge of this opening with thongs, which passed around the heel for the support of the foot. The heel was left free to work up and down, and the opening was designed to allow the toes of the foot to descend below the surface of the shoe, as the heel is raised in the act of walking. It is a very simple invention, but exactly adapted to its uses. A person familiar with the snow-shoe can walk as rapidly upon the snow as without it upon the ground. The Senecas affirm that they can walk fifty miles per day upon the snow-shoe, and with much greater rapidity than without it, in consequence of the length and uniformity of the step." Other tribes made snow-shoes of varied forms and sizes, and a female snow-shoe was extensively used in some regions.

As with the other aids of locomotion devised by the savages, considerable skill was required to render the snow-shoe serviceable. To tyros it was a hindrance or an instrument of torture. Journals of white adventurers or captives who traveled with the Indians on winter expeditions complain bitterly of its annoyances. Ellis says that "the alternative was before them either of giving over in the tramp, or suffering sharply till they had 'caught the hang' of the snow-shoe. Chillblains were but the slightest part of the infliction. The constant friction of the tie over the instep and of the loops over the toes galled the flesh, and the oozing and freezing blood were sorry concomitants for the traveler. Glad was he when the stint appointed for the day's journey was ended, and resting in the camp, though roofless and with a cordon of snow, he could soothe and dress his stinging extremities."

USE OF HORSES BY THE INDIANS.

The Indian appliances for transportation heretofore described relate to those used by them before they were brought into direct or indirect contact with the white race. After European settlements had commenced, the principal change that occurred arose from the introduction of the horse on this continent, and the gradual acquisition of horses by the Indians on the plains, western prairies, and the north-west, mainly by the capture of wild animals descended from horses taken to Mexico by the Spaniards. A comparatively small number of horses were also obtained by savages living east of the Mississippi, as they were receding westward, either by barter, by finding estrayed animals, or by raids upon frontier settlements. The Indians had a great natural fondness for the horse, and their readiness in adapting him to their uses affords a remarkable illustration of their capacity to realize benefits from such concomitants of civilization as accorded with their tastes and antecedent training. East of the Mississippi the horse was used to a limited extent as they saw him used by traders, in carrying burdens, but west of that river, and especially on the plains, he became of great service in peace and war, partly as a beast to be ridden, but also largely as a carrier and drawer of freight. In connection with the last-mentioned class of the uses to which he was applied the general method adopted, especially when an entire tribe changed its location, was to fasten to his back the tent poles of their lodges, which were left to trail behind him, and so arranged as to furnish a support for the skins which formed the tent or lodge, other baggage, and sometimes even for children or women. This contrivance is designated by some writers a travail. Something similar has been adopted in various countries, where, after the horse has been pressed into service, the advance in mechanic arts has not been sufficient to secure the use of wheeled vehicles, or even of convenient sleds, and it forms the most primitive of the devices for using the horse as a draught animal.

It required only a comparatively small amount of experience to enable the Indians to become very expert in capturing and taming or training wild horses, in stealing the horses of settlers or hostile tribes, and they readily devised rude saddles and substitutes for bridles.

To the savages of the plains the horse became a paramount necessity, and he was so highly prized that he formed the principal object of avaricious longings and the type of native wealth. He rendered infinitely more genuine service to them than any other physical boon they indirectly derived from the introduction of the white race on this continent, and it is a curious fact that the conferring of this boon was wholly an involuntary and unpremeditated act on the part of the Europeans. In other words, while nearly all their voluntary and premeditated intercourse with the savages redounded to the injury of the latter, the principal real benefit conferred grew out of the ability of the Indians to capture wild horses and steal tame ones.

The Indian system of transportation, as an entirety, including the devices used subsequent to the introduction of the horse, was as complete as any other portion of their native provision for the wants of life. For the water movements which formed a large proportion, probably nine-tenths, of all their extensive journeys and transfers of freight, they devised canoes of various styles, including some that were very ingenious and skillful. To aid their land movements they had the burden strap; in northern latitudes the snow-shoe, and, to a limited extent, sledges and dogs; and, after horses became available, the travail.

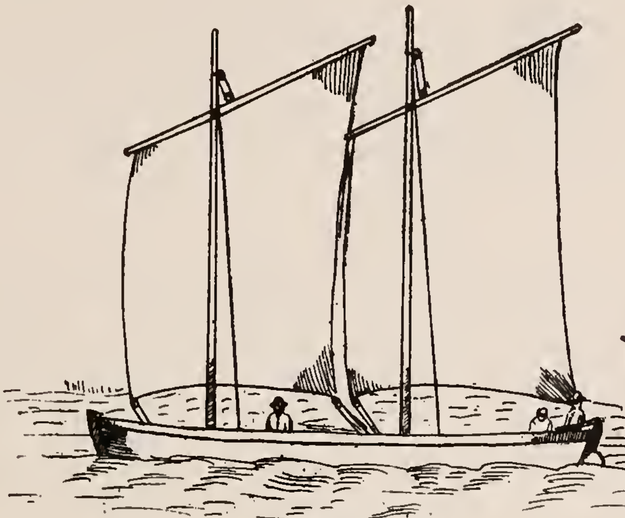
FIRST EUROPEAN SETTLEMENTS.

THEIR DEPENDENCE UPON WATER CHANNELS.

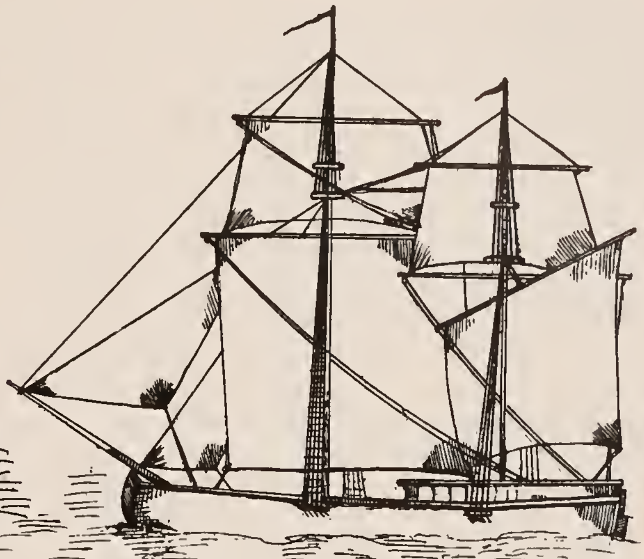
THE pioneer Europeans arrived in the new world in ships which, small as they appear in contrast with the gigantic steamers of the present day, were marvels of size, speed, and capacity in the eyes of savages. The ocean always afforded a possible avenue for retreating or returning to the old world. The early forts, towns, and farms were generally established either on islands or at points which combined ease of access to the ocean with the convenient use of navigable streams, on which boats, canoes, shallops, or other small vessels could be dispatched to every point it was desirable to reach. A water solution of the transportation problem was a prime necessity. Even the advance immigration movement up such magnificent waters as the lower Delaware and the Hudson was very tardy. The early grants of land on the lower Delaware were all along its shores, and the first legal regulations affecting transportation relate to boats, canoes, and landings. Although Swedish settlements had existed in Pennsylvania for some years before William Penn arrived at Philadelphia, no provision for roads had then been made. Land travel was usually conducted on horseback, the Indian trails being used as bridle paths, and the rivers were either forded, or in cases where they were too deep for fording, Indians were induced to carry passengers in their canoes, while the horses were compelled to swim the rivers. A long period elapsed, after most of the early settlements were made, before the natural water-courses, with avenues leading to the ocean, ceased to furnish the main reliance for all extensive movements of persons or property. It required much time to fairly begin any genuine system of internal development, extending materially beyond these water-courses.

The French settlements closely hugged the north Atlantic coast, the St. Lawrence, the lakes, the Mississippi. The Spaniards founded St. Augustine under the impression that Florida was an island. The home of the Puritans was long known as the settlements of Massachusetts bay. The original Rhode Island (but not the present state) was, as its name indicates, an island, possessing superior facilities for water communication. The early settlements in Connecticut were on the banks of the Connecticut river, which had been ascended by Dutch navigators, who had planted trading forts on its banks. The early New York settlements were on Manhattan Island, Long Island, and on the banks of the Hudson. New Jersey is so liberally endowed with aquatic surroundings that there was special propriety in her early name of New Netherlands, and the name of New England, by which the Eastern states are still generally known, was probably founded on the character of her coast, and the abundance of navigable waters extending into interior points. The early Virginia settlements are described as the colonies on the Chesapeake bay, and the extent to which the navigable rivers of the Old Dominion were skirted by fertile lands, from which produce could be economically transported, is one of the chief causes of the prominence she gained in wealth and population during the colonial era. Maryland enjoyed analogous advantages, and her soil was included in one of the early grants which defined the boundaries of Virginia. The early discoverers of North Carolina were charmed with its inlets, islands, and sounds. South Carolina was rich in maritime endowments. The early Georgia settlements were on the banks of the Savannah. Many other pioneer movements on the banks of the gulf of Mexico, the Mississippi, and the Ohio were in accordance with the general law or overriding necessity, which required water channels of communication, because only a modicum of the comforts and blessings of civilization could be obtained at places remote from facilities for navigation; and long periods elapsed before serious and earnest efforts were made to penetrate the bowels of the land, where most of its true wealth was to be eventually found, and to establish convenient avenues by which the productive interior districts could be reached.

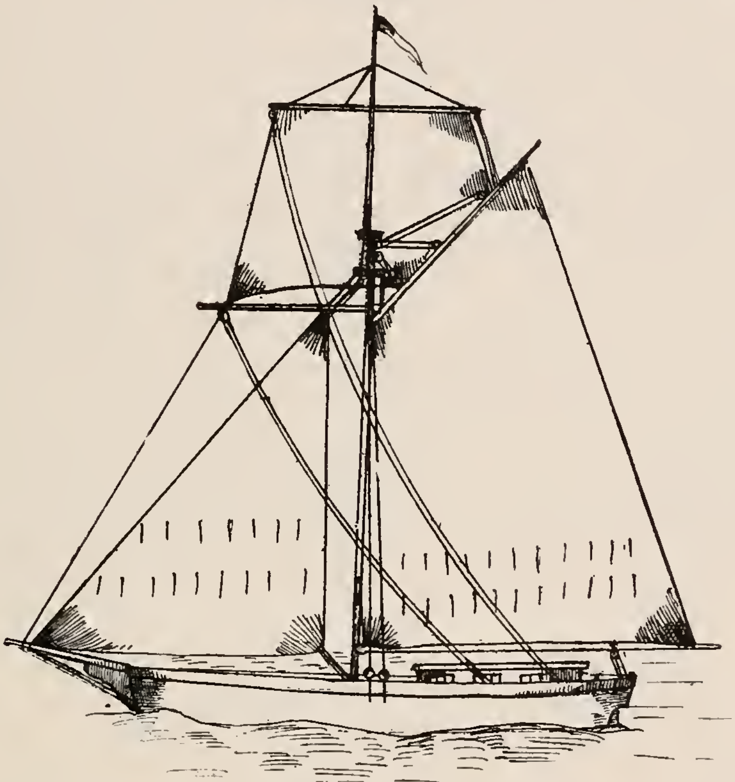
Each of the thirteen original colonies had one or more seaports, and the main current of trade existing during the entire colonial era, and in some respects up to much later periods, was between these ports and the interior districts of the colonies in which they were, respectively, located, on the one hand, and the outer world, via the ocean, on the other. Commerce between the colonies was of limited magnitude, and originally,



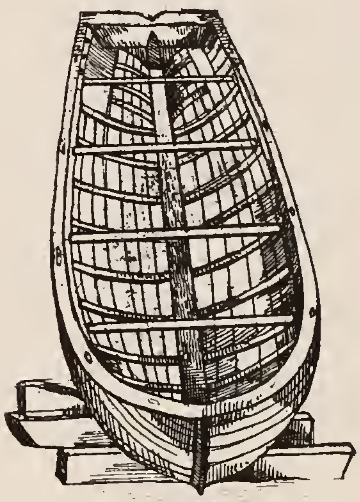
Ancient Shallop.



Ketch of 1692.

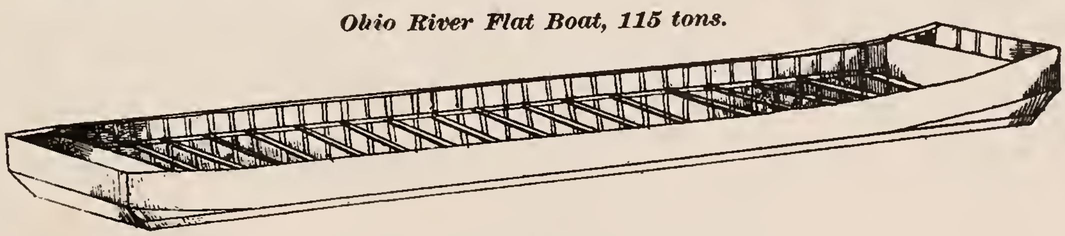


Top-sail Sloop.



Boat.

Ohio River Flat Boat, 115 tons.



Coal Boat or Broad Horn, 950 tons.

nearly all the movements made from one colony to another were conducted in shallops, sloops, schooners, or other sea-going vessels. For some purposes corresponding movements along the Atlantic coast have been continued in water channels up to the present day. The extent to which land routes have been substituted, and the zeal displayed in efforts designed to secure for each of the important seaports the largest attainable share of internal and foreign trade, form pivotal features of many of the greatest events in the transportation development of this country.

PRIMITIVE WATER CRAFT ON THE ATLANTIC COAST.

The first European settlers on the Atlantic coast naturally blended types of old-world vessels with the canoes built by the Indians. For communication between Europe and the young colonies ships built abroad were used, almost exclusively, during a long period. But canoes were freely and generally employed for fishing and in collecting oysters and clams. On some points of the North Atlantic coast adjacent to the famous fishing banks of Newfoundland, a nautical race obtained a foothold at an early date. It was composed of men sent across the ocean by European adventurers and companies for the express purpose of catching fish, and they commenced various forms of ship-building soon after they had formed permanent settlements. The largest vessels of the sixteenth and seventeenth centuries were of comparatively small dimensions. Only a few of those employed in lengthy voyages were of more than 100 tons burthen. The waters of Maine were explored in one bark of 50 tons and another of 26 tons. John Smith's fleet, used in exploring the waters of territory subsequently embraced in Virginia, Maryland, and other colonies was composed of a pinnace or long boat of 20 tons and two vessels of 40 and 100 tons respectively. A favorite style of vessel at the time boat and ship-building was first commenced was the shallop, a term which was generally employed for many years. Out of the original shallop grew two classes of small vessels which have remained in permanent use. One of these is the sloop and another the Chebacco boat or pink. A record of craft owned or built in Massachusetts from 1674 to 1714 designates them under these heads: Sloops, pinks, ketches, brigantines, barks, and ships. Sloops were the most numerous, and the number of pinks, ketches, and barks was very small.

So many changes have occurred in maritime architecture from that day to this, that it would be idle to attempt to describe them in detail in any work not specially devoted to that subject. That task has been accomplished in a very creditable manner, in the census report on the ship-building industry of the United States for 1880, by Henry Hall, special agent. In the progressive stages leading from slow- to swift-moving vessels and from small to large craft, this country held a leading position for a long period, in all matters connected with wooden ship-building. This pre-eminence extended, during some eras, not only to the mechanical features and capacity of the craft, and to the control of our own oceanic or foreign carrying trade, but to the attainment of a leading position in connection with the foreign carrying trade of some other countries.

There have, however, been great vicissitudes in this as well as all other branches of transportation. Before the Revolution American progress in some directions was regarded with jealous eyes by the British government, and development was checked by very harsh and arbitrary measures.

The magnitude that ship-building had attained a few years before the Revolution is illustrated by a report to the House of Commons in 1792, which contains the following statements: In 1769 the colonies built and launched 389 vessels, 113 square-rigged and 276 sloops and schooners, of an aggregate burden of 20,001 tons. Of these, Massachusetts provided nearly one-half, New Hampshire and Rhode Island the next largest number, while New York had only 5 square-rigged vessels, and 14 sloops and schooners, measuring in all 955 tons. Pennsylvania owned 1,344 tons; Virginia, 1,249 tons; North and South Carolina, 1,396 tons, and Connecticut, 1,542 tons, while Georgia had one sloop and one schooner, whose combined measure was only 50 tons. In 1769 the entrances to all the ports of the present United States amounted to 332,146 tons, and the clearances to 339,302 tons, of which 99,121 tons cleared for Great Britain, 42,601 for southern Europe and Africa, 96,382 for the British and foreign West Indies, and 101,198 for the continent of America and the Bahamas. The aggregate value of the whole imports amounted to £2,623,412, and the exports to £2,852,441.

One of the forms of the coasting trade which first attained considerable importance was the transportation of firewood, just as in late years the movement of coal has furnished employment to a large number of vessels. Each important new phase in industrial development has usually been accompanied by a marked change in some of the characteristics of the auxiliary shipping interests. Some of the most important of these changes were those originating in the rapid growth of the cotton-planting operations of the Southern states, and in the discovery of gold in California, the emigration movement to that state by oceanic routes, and the subsequent commercial transactions between Pacific and Atlantic ports.

NAVIGATION OF INTERIOR WATER ROUTES.

TRANSITION FROM THE CANOE TO THE SKIFF OR BATTEAU.

INDEPENDENT of the vessels employed in local or coasting trade tide-water movements, advances made into the interior required minor craft, adapted to shallow streams. The Indian canoes were frequently pressed into service and for a long period continued to be extensively used. The first additions usually made to the available water craft were skiffs, boats, and batteaux. Accounts of military expeditions during the eighteenth century describe movements in which canoes and batteaux were intermingled. The rule which generally prevailed was to use canoes in all cases where the necessity for relying upon Indian methods of construction was urgent, and to build batteaux in most of the instances in which the services of civilized mechanics or boat-builders could be procured. The relative advantages of the rival structures continued to be discussed for a long period, and it is probable that the Indians regarded the batteau as inferior to the canoe, while most white men, having due regard for their safety and convenience, preferred the batteau.

An illustration of the diversity of sentiment which prevailed among the hardy white boatmen who had become accustomed to the management of canoes is furnished by a letter written from Harris' Ferry (now Harrisburg) by Capt. Thomas Lloyd, an agent employed by the colonial authorities of Pennsylvania to the Governor of that province, on March 15th, 1758. He says: "The batteaux being almost worn out, the difficulty of repairing or replacing them will be very considerable. Several persons here have offered to build canoes at their own expense, susceptible of eight or nine barrels of flour, on condition of being employed as batteaux men in the service, and an allowance of provisions during five or six days labor in making them. Mr. Harris and the people best acquainted with this river (the Susquehanna) *assert that canoes are in every respect preferable to batteaux;* that they may be as capacious, or more so; are more durable; that they don't require the same repairs, nor above half the number of hands; that they are not so subject to leaks, and being more buoyant can pass the river and falls when the batteaux cannot. For these reasons I have consented that two or three should be made for a trial, and they are now almost finished. If it is thought proper to encourage this proposal, I believe the province will be quite as well served, the dispatch greater, and the expense less."

In connection with an expedition made five years later in Pennsylvania, in 1763, ten canoes were hired to transport provisions and ammunition to Fort Augusta, and an official report relating to this transaction states that two batteaux belonging to the province were used in connection with the canoes. In the movement of a considerable force of French soldiers and their Indian allies, with cannon and supplies, down the Allegheny to Pittsburgh, about the middle of the eighteenth century, both batteaux and canoes were used, and in 1756 batteaux were used for taking supplies on the Ohio river to Fort Duquesne, and for maintaining communication between that point and French settlements on the Mississippi.

In 1777 the building of batteaux on the Monongahela, under American auspices, commenced, a party of carpenters having been sent out from Philadelphia for that purpose.

A batteau is defined by Webster as "a light boat, long in proportion to its breadth, and wider in the middle than in the ends." An approximately correct idea of the batteaux used in portions of the territory now embraced in the United States may be derived from a description of the labors of the French Canadian boatmen, who were the successors of the Indians in ascending the St. Lawrence, by a traveler who made a journey with them during one of the closing years of the eighteenth century.

He says that "three men are found sufficient to conduct an empty batteau of about two tons burthen up the St. Lawrence, but if the batteau be laden more are generally allowed. They ascend the stream by means of poles, oars, and sails. Where the current is very strong they make use of the former, keeping as close as possible to the shore, in order to avoid the current, and to have the advantage of shallow water to pole in. The men set their poles all together at the same moment, and all work at the same side of the batteau. The steersman, however, shifts his pole from side to side, in order to keep the vessel in an even direction. The poles commonly used are about eight feet in length, extremely light, and headed with iron. On coming to a deep bay or inlet, the men abandon the poles, take to their oars, and strike, if possible, directly across the mouth of the bay; but in many places the current proves so strong that it is absolutely impossible to stem it by means of oars, and they are obliged to pole entirely round the bays. Whenever the wind is favorable they set their sail, but it is only at the upper end of the river, beyond the rapids, or on the lakes, or broad parts of it, where the current is not swift, that the sail by itself is sufficient to impel them forward. The exertion it requires to counteract the force of the stream by means of poles and oars is so great that the men are obliged to stop very frequently to take breath. The places at which they stop are regularly ascertained. Some of them, where the current is very rapid, are not more than half a mile distant one from the other; others one or two, but none of them more than four miles apart."

Canoe movements were made in a similar manner by a number of the pioneers who sought homes near the heads of rivers flowing towards the places first colonized.

Egle's History of Pennsylvania says: "Many of the settlers on the head waters of the Susquehanna river took their families and goods in canoes up that stream. These canoes were generally managed by a steersman and a bowsman, who placed steel-pointed setting poles upon the bottom of the river, upon which they threw their whole weight and force, and thereby propelled their canoes forward, and by such continued efforts frequently made 25 miles a day against the current, carrying in their canoes from three-fourths of a ton to one ton a trip. In case of low water in the streams, the boat crew would be compelled to remove the gravel and fragments of rock from the line of their course, and wade for miles at a time in the stream, carrying and dragging their boats forward."

In Connecticut a flat-bottomed skiff followed the canoe. They were pointed at the bow, were as broad aft as amidships, and were flat on the floor with upright sides, having a little outward flare. At an early day they were used both for fishing and for carrying goods and passengers.

In the census report on ship-building in the United States in 1880, the only reference to batteaux is a statement that about seventy-five of them are built every year, on the Aroostook river, in Maine, for lumbermen, and they are light or fragile boats, or flat-bottomed skiffs, with pointed ends and flaring sides. They are constructed of pine boards, at a cost of from $10 to $25 each, and will carry about half a ton.

THE FLAT-BOAT OR BROAD HORN.

Canoes and batteaux could be used either in ascending or descending rivers. When the yield of surplus products at points on or near interior rivers became of sufficient consequence to render improved facilities for transportation desirable, the custom was established of drawing a broad line of distinction between one class of rude craft intended solely for movements down stream, which included flat-boats, arks, and rafts, and another class which, like canoes and batteaux, could be used either in ascending or descending rivers.

Improvements on the craft used for ascending streams were made, which were known on the upper Delaware as Durham boats, on the Ohio and other streams as keel-boats, and at a later stage, after additional improvements had been made, and a roof provided, as barges. These distinctions have been persistently maintained, and one of the first expedients adopted by the colonists—the use of flat-boats for descending navigation exclusively, with the understanding that at the end of each voyage they should be sold by the original owners—continues to furnish one of the methods for transportation movements on the Ohio and Mississippi and other rivers up to the present day. The raft also survives in many localities. The "ark" has nearly disappeared from American waters. The flat-boat, ark, and raft furnished the principal facilities for conveying to market a large proportion of the bulky products of this country during a protracted period. The flat-boat was probably the first of these agencies to be employed in a number of localities.

Thomas Budd, in his Account of Pennsylvania and New Jersey, published in 1685, says of the uses then made of the Delaware river: "After great rains we may bring down great quantities of goods in flat-bottomed boats, built for the purpose, which will then come down by reason of the floods with speed."

The flat-boat was of various sizes and designated by several names. On the Ohio and Mississippi it gained its highest development and most protracted utility. A writer skilled in nautical affairs says that "the only claim of the flat-boat or 'broad horn' to rank as a vessel was due to the fact that it floated upon water and was used as a vehicle of transportation." The phrase broad horn originated in the fact that many of the flat-boats were provided with large steering oars, hung on fixed pivots on the sides, by which these cumbrous contrivances were managed. During the latter part of the eighteenth and the early portion of the nineteenth century nearly all the adventurous men of the regions west of the Allegheny mountains and contiguous to the Ohio participated in flat-boat movements. To many it was a starting point in life to build a flat-boat, load it with merchantable produce, make a trip to New Orleans, see the world as it was developed in the regions traversed, and return by the best routes and methods that were available, which were all very undesirable.

An important historic trip was made by Messrs. Gibson and Linn, in 1776. They descended the Ohio and Mississippi, from Pittsburgh to New Orleans, and brought back a cargo of 136 kegs of gunpowder, procured from the Spanish authorities and intended for the use of the Continental army. Although they probably used canoes or batteaux instead of flat-boats, it is stated that when they reached the falls of the Ohio, in the spring of 1777, they were obliged to unload their boats and carry the cargo around the falls. The success of their trip gave an impetus to the flat-boat trade, which rapidly increased in magnitude, and which, except during a few temporary suspensions arising from Spanish hostility and the civil war, has continued in one form or another up to the present time.

Independent of the men who aimed at running boats of their own down the river, or who used them to transport their families or household goods to their new homes, many others sought and found employment as flat-boatmen, in the service of the owners of such craft.

The Indianapolis Journal, in discussing this phase of transportation development, says that during early eras a "voyage from Pittsburgh to New Orleans by flat-boat was an enterprise of greater peril than a tour around the world is now. It was certain to be full of adventure. It required months for its accomplishment. A shot from the shore by some Indian or reckless desperado might terminate abruptly the voyage and the lives of the navigators in blood. A moment's neglect of the steersman might wreck the unshapely craft and all the hopes of its owners, hundred of miles from home, and in an inhospitable wilderness. There was danger everywhere, in the currents, eddies, whirlpools, bayous, and snags of the tortuous Father of Waters, but there was no less danger from the half-civilized dwellers on the banks. The outlawed criminals and the desperate adventurers from civilization skulked about the shores or prowled with light canoes among the bayous and creeks, watching for chances to plunder, even if murder was necessary to aid them. A flat-boat voyage down the great river was perilous enough from natural causes, even if man's inhumanity to man had not increased the peril. In those days the Government had not thought of snag-boats, and the Mississippi was full of half-hidden dangers. The current was constantly changing. It was easy to be deceived into an old channel, from which there was no return. Bayous were often traps—watery *culs-de-sac*—leading nowhere but to ruin. The organized river pirates and wreckers were always on the lookout for unwary voyagers, so that a slight mishap generally ended in complete disaster. If, under such circumstances, the flat-boatman reached his distant home, footsore and weary, but penniless, months after leaving it, he was lucky.

"In the early days of flat-boating, a safe return, even when the venture had not proved financially profitable, was a grand event and the occasion of tumultuous joy. The business bred a special class who sought it for its adventure and dangers as much as for its profits. The river pirates met in the flat-boatmen of that early day, a class ready, eager, and willing for the fray—a class which, like the rancheros of the plains, accounted a trip tame and spiritless if unattended with danger. They were rough and ready, careless and care free. Dreamily floating down the Ohio they whiled away with song and dance the lazy hours. The boatman's horn waked the echoes from distant hills more musical than steamboat whistle or that ear-distracting horror, the calliope. It was a romantic life, befitting the grand scenery and rude time. Ninety days on a slowly-moving flat-boat. The scenery constantly changing but ever wild and beautiful, was a thing never to be forgotten. The spice of danger in it only gave it zest. An occasional adventure with river sharks only relieved monotony and added interest.

"It is difficult for one looking on the Ohio river to realize that once flat-boats, broad horns, and the queerest craft that ever floated, did all the transportation business from the head-waters to New Orleans. A flat-boat, scarce moving, with rude arrangements for cooking on deck, almost under water, with long oars awkwardly attached to the sides, is a type of its time almost as grotesque and odd as the Viking ship recently dug up in Norway. Perhaps one day it will excite as much archæological wonder, for it already recalls a time we fail to understand—a condition of society and of our country we can scarcely appreciate. The leisure-loving, deliberate, slow-moving flat-boat was fast enough for its day and people. There was luck in its leisure."

THE EARLY TRADE CONDUCTED ON FLAT-BOATS

consisted largely of the movement of flour and whisky. A variety of miscellaneous articles, however, were transported. Hon. Levi Woodbury, who made a trip down the Mississippi in 1833, in a letter written at Natchez, says: "At every village we find from ten to twenty flat-bottomed boats, which, beside corn in the ear, pork, bacon, flour, whisky, cattle, and fowls, have a great assortment of notions from Cincinnati and elsewhere. Among these are corn-brooms, cabinet furniture, cider, apples, ploughs, cordage, &c. They remain in one place till all is sold out, if the demand be brisk; if not, they move further down. After all is sold out, they dispose of their boat, and return with their crews by the steamers to their homes."

At the present day (1886) flat-boats are still built on the Allegheny river, loaded at Pittsburgh with corn, potatoes, hay, crockery, glassware, liquor, and miscellaneous articles, taken down the river, and trading operations commenced at any point where they can be made profitable. Wheeling is also a favorite starting point for similar expeditions.

One of the most important uses to which flat boats have been applied is

THE TRANSPORTATION OF COAL.

Until 1850 the coal exported from Pittsburgh was floated down the Ohio in large, flat-bottomed boats, which were usually 125 feet long, 16 feet wide, and 8 feet deep, with flat perpendicular sides, bow, and stern. Each boat of this size held about 15,000 bushels of coal, and they were floated to their destination lashed in pairs. The usual complement of hands for such boats was 23 or 24. These boats could only be floated down the river in the high floods that generally, from time to time, in the spring and fall of each year, swell the current of water in the Ohio river.

Subsequently the practice was adopted of forwarding coal from Pittsburgh in coal flats towed by a steam tow-boat and this method, or modifications of it, is claimed to be one of the cheapest methods of transportation ever devised. A notice of this system, in Harper's Weekly, says: "Merely as a sight worth seeing a Pittsburgh steamer with a tow of coal flats is a notable object, for nothing like it can be seen anywhere else in the world but on our inland water-ways. These tow-boats are all 'stern-wheelers.' They carry no load themselves, and, burdened with nothing but their own weight, which is chiefly the weight of their engines, their evolution has been wholly toward the development to the utmost of propelling power. Many of them draw no more than two feet of water. For this peculiar boat architecture, credit is due to Pittsburgh's engineers, and by means of it they have made the cheapest transportation service in the world. Simple as it now seems to build wholly with reference to power, and to spread out the cargo, so to speak, over as indefinite an area as low water makes necessary, this solution of the problem of cheap coal transportation was not reached until the railroads threatened to take away all traffic from the rivers, as they have practically taken away all travel. . . . Pittsburgh coal can be delivered in New Orleans for about $2.60 per ton, and New Orleans is 2,000 miles away by river. Voyages of 4,000 miles are by no means uncommon for these coal carriers to take on our inland waters. Cow Island, on the upper Missouri, is 300 more than 4,000 miles from Pittsburgh, and they carry coal to market there—a distance as great as from New York to any port on the Baltic sea. Not less than 20,000 miles of inland navigable waters are accessible to these Pennsylvania fuel peddlers. More than 160 of them are owned by Pittsburgh owners—a vast fleet, the building of which cost hardly less than $10,000,000. The aggregate of vessels of all kinds is now more than 4,000. Of the 13,000,000 tons of coal that were dug in 1883 in the counties near Pittsburgh, about 4,500,000 tons were carried to market by water."

RETURN TRIP OF FLAT-BOATMEN.

Of the means adopted by the men engaged in the modern flat-boat trade to return to their homes, and of some of the characteristics of lower-river life, the river reporter of the Pittsburgh Chronicle-Telegraph draws a picture which, it is to be feared, is in some respects applicable to too many of the phases of water transportation. He says: "A volume might be written on lower river flat-boat life, and it would be full of interest. Three men generally comprise the 'crew,' and they are paid from ten to eighteen dollars a month. From New Orleans they come home on steamers, taking a deck passage from the Crescent City to St. Louis or Cincinnati, and paying for the same from three to six dollars, according to the number of boats leaving, and the terms they can make with competing river steamers. A 'deck passage' is an idyl of river life in itself, and one that the general world has not the remotest conception of. Two thousand miles, with a state room under the boiler battery, a dining saloon among the mules 'back aft,' and a continual punching up at midnight by the 'mud clerk,' together with the fights and thievery of the semi-barbarous, double-jointed unintelligible Voudoo roustabouts, is a feature of human existence that has to be experienced to be appreciated. On the lower river and its tributaries float hundreds of these flat-boats, bent on all purposes of barter and trade. Legitimate 'traders,' freighted with 'up-river' stuffs, 'bum boats,' peddling dry goods, stationery, and everything else; 'gunboats,' loaded with the refuse of sad existence; whisky boats, which are floating saloons, whose license expires with the cutting of their ropes; photograph boats, pick-ups, and 'pirates.' These last are a buccaneer feature of the river, about which wild tales, too often true, are told. They all form a wonderful link in internal commerce, as wonderful as it is unknown, and Pittsburgh is the natal place of this queer industry of western water-ways."

ARKS AND RAFTS.

THE other craft used extensively and exclusively in descending streams were arks and rafts. On some rivers the former preceded the latter, for the reason that original obstructions to navigation could be more readily surmounted by them, and after these obstructions were removed the use of rafts was continued long after the construction of arks had ceased.

Arks were favorite craft for transporting miscellaneous products from regions in which lumber was cheap and abundant to comparatively distant points that could be reached by river in Pennsylvania, New York, and on the Ohio, during a protracted period. They were used during the eighteenth century, and at some places were only superseded after canals were constructed, and the use of steamboats had become general.

Before the construction of the Erie canal, the farmers of central and western New York sent their produce to market in arks down the Delaware and Susquehanna.

The farmers of Pennsylvania who resided at points contiguous to these rivers adopted the same method. Some of the early shipments of anthracite coal were made in arks. Their size varied with the uses to which they were applied. Some of those used in Pennsyvania were large enough to carry 500 barrels of flour. Of the arks used in transporting coal from the Wyoming valley it is stated that they were "rudely constructed craft, 90 feet long, 16 feet wide, and 4 feet deep, with a capacity of 60 tons. Each end terminated in an acute angle, with a stern post surmounted by a huge oar, some 30 feet in length, requiring the strength of two stout men to ply it. Some 10,000 feet of lumber was used in the construction of the ark, and its total cost was $70. It took four men seven days to navigate it to tide-water, the cost of the trip being about $50. Only two-thirds of the arks started down the river reached their destination, one-third generally going to pieces on the bars and rocks. It cost $181 to get 60 tons of coal to market, or about $3 a ton. The perils of navigation increased the cost of transportation to fully $4. Added to this were commissions on sales, cost of transhipment, and other expenses, bringing the whole outlay on a ton of coal up to $5. Coal sold at $10 a ton at the time, leaving a profit of $5."

Of the movement down the Lehigh, of six arks of coal, which was attempted in 1803, the following account is published: "The descent of the river, for the first 15 miles from Mauch Chunk, was exceedingly rapid, the fall being some 300 feet. It was a bright and cheerful morning, after the stream had attained the usual high-water mark, that the arks were cut loose, and, each equipped with six men, began at once the descent of the rapids. Now the torrent roars—the waves and whirls dash madly around the boats; the men at the oars, with faces wild with animation and excitement, and with muscles full distended, run to and fro upon their narrow platforms; the pilot, with energetic motion and speech, addresses the steersman—the steersman, with like gesticulation and vehemence of manner, responds to the pilot—and then all hands make desperate plunges at the oars! Now the boat, shaking and cracking, swings its cumbersome form around a villainous rock; now it sheers off, in a counter-current, towards the shore, and then bending round, again dashes forward into the rolling waves, when—cr-a-sh! je-boom! it rises securely upon a ledge of rocks half concealed beneath the surface of the water! A moment serves to contemplate the wreck, and then the men, seizing oars and planks, make good their exit to the shore—leaving the broken and dismembered ark to its fate, and the cargo to the curious speculation of the catfish and eels. Of the six which embarked, but two reached Philadelphia, and even these presented a very dilapidated appearance."

In a letter describing early efforts to transport Lehigh coal to Philadelphia, written by Mr. Charles Miner in 1833, he says that in August, 1814, the firm with which he was connected started off the first ark they had constructed. It was 65 feet long, 14 feet wide, with 24 tons of coal. The expenses he reports as follows:—

Expenses of the passage and hands down and returning	$28 27
Wages, including three pilots	47 50
	$75 77
Ark (cost high, from inconvenience of building)	$130 00
Twenty-four tons coal, raising from mine	24 00
Hauling nine miles to landing, at $4 a ton	96 00
Loading into ark	5 00
	$330 77

So that, in the first experiment, the coal cost about $14 a ton in the city. He adds: "I have been somewhat minute in giving you these details, because this ark was the pioneer, and led off the coal trade by the Lehigh to Philadelphia, now so extensive and important. This effort of ours might be regarded as the acorn from which sprang the mighty oak of the Lehigh Coal and Navigation Company." In a note he says: "The fact may not be uninteresting that we were obliged to pay $4 and for much of the coal hauled $4.50 a ton over an exceedingly rough road of nine miles, where now, by railway, it is transported for twenty-five cents a ton."

Movements on the Ohio, in which arks were used for the transportation of emigrating families, with all their live stock, are described in an account of Major Stephen H. Long's expedition from Pittsburgh to the Rocky mountains, performed in 1819 and 1820. It says: "The little village of Olean, on the Allegheny river, has been for many years a point of embarkation, where great numbers of families, migrating from the northern and eastern states, have exchanged their various methods of slow and laborious progression by land for the more convenient one of the navigation of the Ohio. From Olean downward the Allegheny and Ohio bear along their currents fleets of rude arks laden with cattle, horses, household furniture, agricultural implements, and numerous families having all their possessions embarked on the same bottom, and floating onward toward that imaginary region of happiness and contentment, which, like the 'town of the brave and generous spirits,' the expected heaven of the aboriginal American, lies often 'beyond the place where the sun goes down.'

"This method of transportation, though sometimes speedy and convenient, is attended with uncertainty and danger. A moderate wind, blowing up the river, produces such swells in some parts of the Ohio as to endanger the safety of the arks, and the heavy, unmanageable vessels are with difficulty so guided in their descent as to avoid the *planters*, sunken logs, and other concealed obstructions to the navigation of the Ohio. We have known many instances of boats of this kind so suddenly sunk as only to afford time for the escape of the persons on board."

Good reasons for the abandonment of the ark after turnpikes and canals were constructed, and descriptions of some of the old methods of conducting transportation on the Susquehanna and its tributary regions are contained in the following extract from a report made in 1827 by one of the early canal commissioners of Pennsylvania: "Since the opening of the Erie Canal and the construction of turnpike roads, from the Susquehanna to the valley of the Delaware, the Hudson, and the lakes, the boats upon the Susquehanna, for the transportation of the ascending trade, have gradually disappeared, until not a single boat is found plying upon the river above Northumberland. It is found that merchandise can be transported, by wagons, from the city of Philadelphia, the city of New York, and the heads of the Seneca and Cayuga lakes, with more expedition, at less expense, and less hazard, than by the river. [Here the uncertainties and losses attending upon the descending navigation of the Susquehanna are described at length, and the writer proceeds to say:] The losses occasioned by accidents incident to the river navigation, exposure to the weather, &c., is estimated at five per cent. upon the gross amount of exports. The whole amount of property which descended the Susquehanna last year (1826) was estimated at $4,500,000. The tonnage required for the transportation of those articles which could not be floated in rafts, must have amounted to more than 100,000 tons. Fifteen hundred arks arrived at Port Deposit, and it is known that there were many, and it is fair to presume at least 500, found a market for their loading, at the towns and places along the river, above that place. Estimating the loss incident to river navigation at five per cent. which is certainly very low, and the amount of exports at $4,500,000, the gross amount of loss annually sustained, would be $225,000. Besides this, there is, and must always continue to be (whatever improvements may be made in the descending navigation), an enormous sacrifice in the item of arks. An ark of sufficient capacity to carry forty or fifty tons, will cost at least sixty-five dollars. It can never reascend the river; and consequently must be sold for any price which can be obtained for it. The average price of the ark, at the place of destination, is fifteen dollars. The loss, then, upon two thousand arks, the estimated number which descended the river last year, and which is annually increasing, will amount to one hundred thousand dollars; which added to the estimated loss by accident, exposure, &c., amounts to the enormous sum of $325,000."

An illustration of the extent to which arks and rafts were used is furnished by the fact that a report presented to the Pennsylvania legislature in 1829 quoted the following statement:—

"From an accurate account, kept by a respectable citizen of Harrisburg, it appears that between the 28th of February and the 23d of June, 1827, there passed that place:—

Rafts, 1,631; arks, 1,370. It is supposed that the rafts contained, on an average, 25,000 feet of lumber, which would amount to 40,775,000 feet.

Two hundred of the arks were laden principally with anthracite coal, averaging 55 tons each, making 11,000 tons.

The remaining 1,170 arks were loaded principally with flour and whisky for the Baltimore market, and carried, on an average, 400 barrels each, making 468,000 barrels.

It is supposed that about 300 keel-bottomed boats, carrying from 800 to 900 bushels of wheat each, descended during the same period; say 800, makes 240,000 bushels of wheat, at 35 bushels to the ton, makes 6,857 tons."

Annals of Luzerne county say that 30 lumber rafts passed down the Susquehanna in 1796. In 1804 sawed lumber went down—552 rafts, with a total of 22,000,000 feet.

In six days, from May 18th to 23d, 1833, 3,480 rafts were floated down the North Branch of the Susquehanna by the village of Catawissa. In 1840 the lumber floated down the Susquehanna in rafts was estimated at 250,000,000 feet.

RAFTING LUMBER AND TIMBER.

On many of the streams of the United States rafting lumber has continued on an extensive scale during high-water periods, and on a considerable number of streams such movements are the only important transportation use to which those streams or rivers are applied.

The rafts floated on the Susquehanna in 1885 were usually 29 feet wide, 300 feet long, and composed of 120 logs or "sticks." The logs are 30 to 40 feet long, and the entire structure contains 11,000 cubic feet of lumber. Most of the lengthy timber has been cut off, and logs now sent down are somewhat dwarfed.

From the lumber regions pilots floated rafts to Marietta for $75 to $80 each; Marietta to Peach Bottom, 28 miles, $40 to $45 per raft; Peach Bottom to Port Deposit, 16 miles, $22.50 per raft. The pilot paid his hands $3.50 and steersmen $5 per trip from Marietta to Peach Bottom; Peach Bottom to Port Deposit hands get $2.25 and steersmen $2.75. When the river is in good condition the run from Marietta to Port Deposit could be made in eight hours. After the rafts arrived at the latter place about twenty of them were lashed together, and towed by tug-boats to Chesapeake canal. There rafts of sufficient number were piled upon each other, and were termed lockages. From the canal they were taken by water to Camden, New Brunswick, New York, Philadelphia, and other cities, and received by owners and speculators.

Almost every rock and projection along the Susquehanna, from Marietta to Port Deposit, has a name familiar to the raftsmen. In many instances these points received their titles from the fact that rafts were once stove on them. Here are a few of the odd names: "Spinning Wheel," "Sour Beer's Eddy," "Blue Rock, "Turkey Hill," "Brothers," "Old Cow," "Hangman's Rocks," "Horse Gap," "Ram's Horn," "Slow and Easy," "Hollow Rock," "Hog Hole," "Sisters," "Old Port Bridge." Every season, at the conclusion of rafting, "party rafts" came down the river. Upon a raised platform on the logs merry lads and lasses dance as the raft floats through many miles of wild scenery on either side.

On the Allegheny, when timber rafts are run out of the creeks, they are made up into fleets, nine rafts being usually put into one fleet, which contains from 300,000 to 500,000 feet, linear measure.

There is a growing tendency in connection with the lumber business formerly conducted on that and a number of other rivers, including the upper Mississippi, which has been one of the greatest theatres of lumber-rafting operations, to substitute railway for rafting movements, partly on account of the serious losses sometimes arising from unexpected freshets.

ASCENDING NAVIGATION.

DURHAM BOATS.

NONE of the craft heretofore described were used to a considerable extent by parties who made the carrying of freight or passengers a regular business. In most instances the men who controlled the operations of canoes, batteaux, arks, or rafts, owned them, and all their movements, as a general rule, represented the kind of independent operations typified by the expression "every man paddled his own canoe." That remained, indeed, the ordinary custom in reference to a very large proportion of all the internal transportation of the country for a long period after the first colonial settlements were made.

To a limited extent, however, keel boats began to be pressed into common carrier service during the latter half of the eighteenth century, and for many years they continued to furnish almost the only description of craft in which such service was rendered on tideless rivers. They were also extensively used by parties engaged in important freight movements which required that rivers should be ascended as well as descended.

Durham boats, which are supposed by some writers to have suggested the type of boats known as keel-boats on the Ohio and other rivers, were first built about 1750 on the Delaware river bank by Robert Durham, the manager and engineer of the Durham Furnace, in the northern part of Bucks county, and the boat was made nearly in the shape of an Indian canoe. Pearce, in his Annals of Luzerne, says: "Durham boats were 60 feet long, 8 feet wide, and 2 feet deep, and when laden with 15 tons drew 20 inches of water. The stern and bow were sharp, on which were erected small decks, while a running board extended the whole length of the boat on each side. They carried a mast with two sails, and were manned by a crew of five men, one steering, and four pushing forward with setting poles, two being on each side." In the navigation of a number of eastern rivers, these boats were of much service, and they closely resembled the "keel-boats" used on western rivers.

KEEL-BOATS AND BARGES.

The use of keel-boats began on the rivers of western Pennsylvania some time before the close of the eighteenth century. They were built like the hulls of modern canal boats, and would carry, on an average, about 30 tons. They were propelled by sails, pushed by poles, or towed by horses, which walked along the banks, and they made voyages both up and down the streams. As they made regular trips, they were a great convenience in their day for passengers as well as for freight. At first passengers were compelled to land every night, and they lodged at the most convenient farm-house, every man's house in those days being open for the entertainment of wayfarers. Keel-boats were used on the Allegheny along its upper course long after canals connected Pittsburgh with the east.

A line of mail boats was established from Wheeling to Limestone (Maysville), Ky., in July, 1794, to run once every two weeks. These boats were built like whale-boats, were 24 feet long, were steered with a rudder, and were manned by one steersman and four oarsmen, who carried muskets and ammunition.

In 1794 packet-boats for passengers began to run down the Ohio from Pittsburgh. For protection from hostile Indians they were built strongly, and carried cannon and other arms. Passengers slept on these packets.

When the keel-boat was covered with a roof, lengthwise, it was dignified with the name of barge. In reference to their operations a pamphlet issued by the Empire Transportation Company, in 1876, says:—

"On the Susquehanna, a tideless river,—wide, rocky, and except when flooded, extremely shallow,—long, covered barges, carrying, perhaps, a thousand bushels of grain, manned by a captain and crew of eight, was floated at high water from the upper valleys to Columbia. Some twenty tons of merchandise comprised its return cargo. It was a light task to drift southward on the swift waters rolling seaward, but the homeward journey up the stream was insufferably tedious and laborious. Four of the crew on each side of the barge pushed its slow length along by a continuous thrust of iron-shod poles against the river bottom. About five days were consumed from Williamsport to Columbia, while the round trip occupied perhaps eighteen. The charges on grain were ten or twelve cents per bushel, and on merchandise, about fifty cents per hundred pounds."

Some of the keel-boats used on the Ohio were of comparatively large dimensions, being from seventy-five to one hundred feet in length, a breadth of beam ranging from fifteen to twenty feet, and carrying capacity of sixty to one hundred tons. The receptacle for freight occupied a considerable portion of the hulk, and was called a cargo box. Near the stern was a small apartment that served as a cabin for passengers willing to pay for such accommodations. The roof of this cabin was elevated above the main deck, and from this roof the helmsman directed the movements of the boat. The boat was usually provided with a mast and sail, but when no wind prevailed to waft the craft on its voyage oars and poles were substituted, while at other times the hardy boatmen had recourse to the rope, in which case each member of the boat's crew performed the service of a mule on the towpath of a canal.

PERILS OF OHIO PACKET-BOAT TRAVEL.

An interesting picture of the perils to be encountered in navigating the upper Ohio, from the savages and white desperadoes who lurked upon its borders, and of the means devised for averting them, as well as of other peculiarities of the era preceding the present century, is furnished by the following advertisement, printed in Cincinnati, of the first regular packet line between Pittsburgh and Cincinnati, which was formed January 11th, 1794, by four keel-boats of twenty tons each: "Ohio Packet Boats—Two boats for the present will start from Cincinnati to Pittsburgh and return to Cincinnati in the following manner, viz.: First boat will leave Cincinnati this morning at 8 o'clock, and return to Cincinnati so as to be ready to sail again in four weeks from this date. Second boat will leave Cincinnati on Saturday, the 30th inst., and return as above; and so regularly, each boat performing the voyage to and from Cincinnati to Pittsburgh once in every four weeks. The proprietor of these boats having maturely considered the many inconveniences and dangers incident to the common method hitherto adopted of navigating the Ohio, and being influenced by a love of philanthropy, and a desire of being serviceable to the public, has taken great pains to render the accommodations on board the boats as agreeable and convenient as they could possibly be made. No danger need be apprehended from the enemy, as every person on board will be under cover made proof to rifle balls, and convenient port-holes for firing out. Each of the boats is armed with six pieces, carrying a pound ball; also, a good number of muskets, and amply supplied with ammunition, strongly manned with choice men, and the master of approved knowledge. A separate cabin from that designed for the men is partitioned off in each boat for accommodating the ladies on their passage. Conveniences are constructed on board each boat, so as to render landing unnecessary, as it might at times be attended with danger. Rules and regulations for maintaining order on board, and for the good management of the boats, and a table accurately calculated for the rates of freightage, for passengers, and carriage of letters to and from Cincinnati to Pittsburgh; also, a table of the exact time of the arrival and departure to and from the different places on the Ohio between Cincinnati and Pittsburgh, may be seen on board each boat, and at the printing office in Cincinnati. Passengers will be supplied with provisions and liquors of all kinds, of the first quality, at the most reasonable rates possible. Persons desirous of working their passage will be admitted, on finding themselves subject, however, to the same order and directions from the master of the boats as the rest of the working hands of the boat's crew. An office of insurance will be kept at Cincinnati, Limestone, and Pittsburgh, where persons desirous of having their property insured may apply. The rates of insurance will be moderate."

COMMERCE BETWEEN SOUTHERN OHIO AND NEW ORLEANS.

A good idea of the system then prevailing on eastern as well as western rivers is furnished by Judge Burnett's description of the conditions under which the early settlers of southern Ohio conducted commercial intercourse with New Orleans. He says that "no artificial roads had been made; canals had not been thought of; the natural impediments in the rivers of the country rendered their navigation difficult and hazardous at all times, always tedious and often impracticable; and, whenever the water was at its most favorable stage, the distance of the markets, the imperfect means of transportation, and the low price of produce were such that a large portion of the avails of a cargo was consumed by the expense of taking it to market. The water crafts were pirogues, flat-boats, keel-boats, moved by oars and setting poles. The average time required to make a trip to New Orleans and back to Cincinnati was six months. The crafts made use of were necessarily small and the cargo proportionally light, and when they arrived in New Orleans in flat-boats which could not be taken back, the boats were abandoned and the hands returned by land, most generally on foot, through a wilderness, inhabited by Indians, of seven or eight hundred miles. Pirogues and keel-boats returned loaded with such articles as the market of New Orleans afforded. (A pirogue is defined in Knights American Mechanical Dictionary as a large double canoe formed of a hollowed trunk of a tree or of two canoes united.) Under such disadvantages *the commerce of the country was nominal*, and nothing but necessity prompted the inhabitants to engage in it. The farmer had no motive to increase the products of his fields beyond the wants of his family and of immigrants, or 'new comers' as they were called, who might settle in his immediate neighborhood. For many years these immigrants created the only demand which existed in the interior settlements for the surplus products of agriculture. Corn and oats rarely commanded more than ten or twelve cents a bushel; they were frequently purchased at eight cents, and wheat from thirty to forty cents. The average price of good beef was one dollar and fifty cents per hundred, and pork from one to two dollars, according to quality."

IMPROVED OHIO KEEL-BOATS.

In 1833, when the Ohio keel-boats had probably attained their highest development, Hon. Levi Woodbury, gave the following description of them, in a letter written from a point on the river shore of Indiana, as he was journeying down the river: "Keel-boats are formed in their bottom like a small schooner, with a raised roof on deck in the centre, almost the whole length, sometimes with one mast and a sail, and with small cleats or steps each side, the whole length, where the boatmen walk, and push the boat against the stream with their long poles;—no oar is used, except by the helmsman. They are sometimes towed up by the steamboats, but it is an unpopular innovation."

TEAM-BOATS.

Another species of craft pressed into common carrier service to a limited extent, principally as ferry-boats, was the team-boat, or boats propelled by horse-power. A similar expedient was adopted on the waters of the Mediterranean by the Romans many centuries ago. Team-boats were used at some of the ferries leading from New York for about ten years, from 1814 to 1824. They were of eight-horse power and crossed the rivers in from twelve to twenty minutes.

An attempt to use a team-boat in making a voyage from New Orleans to Louisville in 1807 proved unsuccessful, as the experiment was abandoned before the vessel arrived at Natchez. A team-boat was also run at one time between Burlington and Bristol, on the Delaware, as appears by the following advertisement:—

BURLINGTON AND BRISTOL TEAM-BOAT FERRY.

The subscribers having purchased the boat, fixtures, privileges, &c., of the Burlington and Bristol Team Boat Company, and having at a heavy expense put the boat in *complete order*, with satisfaction inform the public, that they are enabled to cross more regularly and in much less time than heretofore.

They will run the boat until prevented by ice, starting from Bristol every morning at sunrise, and crossing every half hour during the day, *passengers or not.*

Sportsmen and others going to the *grouse plains or shire*, from Philadelphia, Montgomery, and the lower part of Bucks county, will find this their most eligible route.

The proprietors pledge themselves that no exertions shall be wanting to render this ferry every way an accommodation to the public.

Fare for foot passengers, six and a quarter cents; for carriages, gigs, wagons, horses, &c., lower than at any other ferry between Trenton and Philadelphia.

Persons crossing in the *team-boats* will be expected to pay their ferriage to the captain of the *team* boat, or at the bar of *Mr. Bessonett* or *Shepherd.*

J. PHILLIPS,
J. BESSONETT,
DOWNING & WOOD,
B. SHEPHERD.

Bristol, October 11, 1829.

P. S. Since her repairs the boat has crossed in eight minutes with the tide, and in fifteen minutes against it.

ECONOMIC RESULTS OF THE PRIMITIVE WATER METHODS.

The primitive water methods described constituted the principal reliance for all lengthy interior freight movements up to the period when they were superseded, to a great extent, by canals and steamboats. Long land movements of bulky freight were rarely attempted, because on inferior roads their average cost was about $100 a ton for 300 miles, or 33⅓ cents per ton per mile. Descending navigation was so much cheaper, notwithstanding the numerous risks and perils it involved, that it was the favorite expedient wherever and whenever it was practicable.

The relation that generally existed between it and ascending navigation, and the cost of the latter, is probably stated with approximate accuracy in an argument made by Robert Fulton, in 1814, in favor of the construction of the Erie Canal, in which he stated that at that time "from Louisville to New Orleans, a distance of 1,545 miles, the freight is $1.50 a barrel, but to come up from New Orleans to Louisville it is $4.50 a hundred weight, or $9 a barrel." The latter figures are at the rate of 5.8 cents per ton per mile, while the down-river movements were made at the rate of about one cent per ton per mile. The charge for down-stream movements, or descending navigation, did not present insuperable obstacles to the movement of cheap and bulky articles over long distances. The up-river or ascending navigation charges could be borne without serious inconvenience by expensive merchandise, but not by cheap products which were moved over long distances.

Of miscellaneous agricultural products and requirements, Robert Fulton, at an early day, wisely said: "Let us look at the rich productions of our interior country, wheat, flour, oats, barley, beans, grain, and pulse of all kinds, cider, apples, and fruit of all kinds, salt, salted beef, pork, and other meats, hides, tallow, beeswax, cast and forged iron, pot and pearl ashes, tanners' bark, tar, pitch, rosin, and turpentine, hemp, flax, and wool, plaster-of-paris, so necessary to our agriculture, coals and potter's earth for our manufactures, marble, lime and timber for our buildings. All of these articles are of the first necessity, but none of them can bear the expense of the $5 the cwt. to be transported 300 miles on roads. . . . It is necessary to bind the states together by the people's interest, one of which is to enable every man to sell the produce of his labor at the best market, and purchase at the cheapest. This accords with the idea of Hume, 'that the government of a wise people would be little more than a system of civil police, for the best interest of man is industry, and a free exchange of the produce of his labor for the things which he may require.' On this humane principle, what stronger bonds of union can be invented than those which enable each individual to transport the produce of his industry 1,200 miles for 60 cents the cwt.? Here, then, is a certain method of securing the union of the states, and of rendering it as lasting as the continent we inhabit."

The cheap rates last mentioned were referred to as one of the principal blessings of canals. Very little aid was derived from them, or even from steamboats, however, in miscellaneous trade movements during the first quarter of the nineteenth century, and until that probationary period had expired comparatively limited direct benefits were derived from many vain efforts to improve the facilities for water transportation by constructing canals, and making arrangements for building a large number of steamboats.

UNSUCCESSFUL EARLY STEAMBOAT EXPERIMENTS.

WHILE the serious attention of the advanced legislators and progressive minds of the United States, shortly after the close of the American Revolution, was turned rather to the improvement of rivers, connections between rivers, and water systems, than to improvements of roads, some of the inventive minds of the country began at a comparatively early period to devise mechanical contrivances for facilitating navigation against the current, or up-stream. This impulse grew naturally out of the marked contrast between the ease with which comparatively heavy loads could be sent down rivers to seaport cities, and the great difficulty and enormous expense involved in conveying a return cargo, or even empty boats of considerable size, back to the original starting point.

Such obstacles continued to be the stumbling-block of American transporters, and the chief incentive to the efforts of the early inventors.

PLANS TO IMPROVE UP-RIVER CRAFT.

Difficulties on eastern as well as western rivers prompted the pioneer efforts made by Dr. Benjamin Franklin, James Rumsey, of Virginia, and John Fitch, to improve the methods for moving water craft up rivers.

In the long and bitter controversy relating to the originality of rival claims to the honor of inventing or projecting a practicable steamboat, the friends of Fitch claim that the preceding efforts of Rumsey were directed to the construction of a boat that could be propelled by mechanical powers. In support of this theory, they assert that a petition presented by Rumsey to the assembly of Pennsylvania, in November, 1784, stated that the boat he contemplated "was to be propelled, by the combined influence of certain mechanical powers thereto applied, the distance of between twenty-five and forty-five miles per day, against the current of a rapid river, notwithstanding the velocity of the water should move at the rate of five miles the hour, and upwards, with the burden of ten tons on board, to be brought at no greater expense than of three hands."

In a pamphlet, issued by Mr. Rumsey, he says: "In the month of September, 1784, I exhibited the model of a boat before his Excellency, General Washington, at Bath, in Berkeley county, calculated for stemming the currents of rapid rivers only, constructed on principles very different from my present one (1788.) Satisfied with the experiment of her making way against a rapid stream by the force of the stream, the general was pleased to give me a most ample certificate of efficiency."

The most vital point of this controversy, so far as it affects the main subject under consideration, is the indication afforded of attention to the problem of devising improved methods for moving boats up stream before projects for applying steam as a motive power, and constructing steamboats, had gained a tangible shape.

THE FITCH AND RUMSEY STEAMBOATS.

Whether Fitch or Rumsey was the first of Americans to attempt to construct a steamboat, it is certain that they both made vigorous efforts in or shortly after 1785 to prosecute that important undertaking; and there seems to be little doubt that Rumsey had been making experimental efforts to propel boats up-stream by labor-saving or mechanical contrivances before Fitch attempted to construct a steamboat. It is a notable circumstance that both Fitch and Rumsey, after reaching a stage of considerable advancement in the construction of a practicable craft for navigating American rivers in both directions, went abroad to obtain the means to complete an invention which was regarded as very important by their progressive countrymen, because repeated trials had demonstrated that it was impossible to gain either from private individuals, organized companies, or public bodies, at home, the comparatively trifling sum that would have probably insured their success. This failure to obtain the requisite pecuniary assistance was specially notable in the case of Fitch, in view of the fact that he had constructed a boat propelled by steam as early as 1788, which made a successful trip between Philadelphia and Burlington, and a few years later a considerable number of trips were made with entire mechanical success from points on the Delaware above and below Philadelphia.

Notwithstanding this positive proof of the utility of the general idea advanced, and the continuance of urgent appeals, by Fitch, for means to continue his experiments, steamboats only became a practical reality on American waters about twenty years later, and then mainly through the efforts of Robert Fulton, who had gained much useful knowledge by a protracted sojourn in France and England which afforded opportunities for becoming familiar with European efforts to utilize steam in propelling boats, and who had the good fortune to find an associate able and willing to advance the requisite capital.

It is a noticeable fact that Robert Fulton rendered a very important service to the transportation interests of his native state and country, by calling attention in a very pointed manner to the value of the canal and turnpike improvements of England, years before he became prominently connected with American steamboat enterprises. The troubles which beset the unfortunate Fitch belong to the era following the close of the Revolution; and the events connected with his career forcibly illustrate the deplorable condition of all matters relating to transportation. Nothing could well be more suggestive than his failure to obtain a few thousand dollars to continue his experiments and improve his appliances, after he had constructed a steamboat that ran for several months consecutively, at regular intervals, on the Delaware, without serious interruption, and the substantial abandonment for nearly a score of years of the prosecution of the great ideas he had advanced.

MISFORTUNES OF FITCH AS A TRANSPORTER.

It is also noticeable that the disastrous results of an attempt he made in the spring of 1782 to take a cargo of flour from Fort Pitt (now Pittsburgh) down the Ohio and Mississippi to New Orleans with the intention of returning thence to Philadelphia, probably helped to give a vivid idea of the benefits which steamboats would confer upon future navigators of these rivers. In company with three other adventurers, a large boat was chartered. It was accidentally run aground on an island in the Ohio, opposite the mouth of the Muskingum, and being somewhat careless in the management of their affairs the entire party and all their cargo were captured by a band of hostile Indians. They were marched overland as prisoners to Detroit, and compelled to carry some of their own confiscated property over this toilsome journey.

Fitch's biographer, Mr. Thompson Westcott, states that the Indians made "up the goods in bundles, graduating the weight according to the strength of those who were to carry them. Some of the prisoners were loaded with thirty pounds, but Fitch, who was not robust, was only burdened with a pack weighing seven or eight pounds. The Indians themselves took much heavier bundles, some of which weighed as much as sixty pounds."

ESTIMATES OF THE COST OF UP-RIVER MOVEMENTS.

Independent of the personal perils involved in movements on western waters, the cost of making them by the primitive methods was enormous. Fitch discussed this subject on several occasions. In an address he prepared for publication in 1787 he said:—

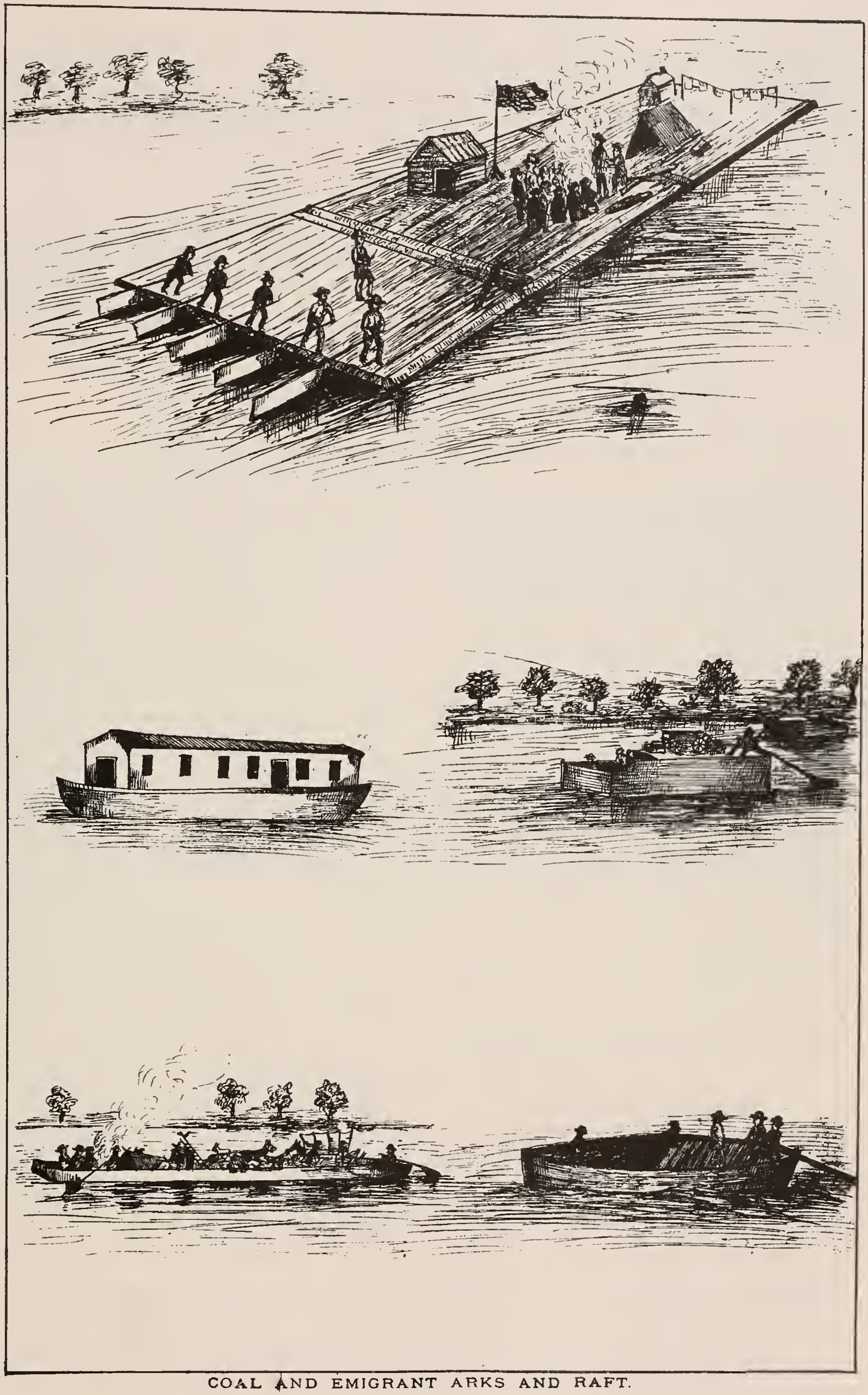
"Where streams constantly tend one way, great advantage will accrue to inland navigation; and in particular to the Mississippi and Ohio rivers, where the God of Nature knew their banks could never be traversed with horses, and has laid in a store of fuel on their head waters sufficient to last for the latest ages, for the very purpose of navigating their waters by fire; an estimate of which I beg leave to make: It takes thirty men to take a boat of 30 tons burthen from New Orleans to the Illinois. Their wages, provisions, taffy, and other perquisites, cannot be estimated at less than one hundred dollars per man per trip; which must cost three thousand dollars to transport 30 tons to and from New Orleans to the Illinois. Now, I say, could I be enabled to complete the experiment, I will obligate myself to make a boat of 60 tons burthen, with the engines and all complete for the voyage for two thousand dollars; and as that could work double the hours as men at oars, it could go in half the time, and transport 120 tons in the same time the other would 30 tons; which *at the rate they now charge, would pay for itself and clear ten thousand dollars,* whilst one boat could make one trip—and larger boats could be made to greater advantage. It would also raise the value of land in the western territories in proportion."

Another striking estimate of the advantages or profits that could be derived from the use of steamboats on the western waters is contained in a letter, addressed by Fitch to Robert Morris, on September 20th, 1790, from which we extract the following: "The great embarrassments of navigating the Mississippi have undoubtedly prevented New Orleans from flourishing in proportion to the extent of the country which must finally traffic there.

"The amazing expense of transporting back the people who transport the produce down that river makes it truly discouraging to the exporter, and a natural tendency of indolence in the planter. From the luxuriance of the soil, the number of inhabitants, it ought to be supposed that New Orleans should be the largest city in North America, and the greatest trade carried on there, which, was the navigation made easy, I apprehend, would suddenly take place. In the first place, I wish to state the difference between the present mode of navigation and navigating those waters by steam, and make an estimate of one boat, for one year, of 50 tons' burthen, and to compare it with Dr. Flowers', Con Barber's, and Captain Wood's certificates.

"I suppose a steamboat of 50 tons' burthen, which would make four trips in a year to Kentucky, or the Illinois, and suppose the boat to be double manned, and to reckon nothing for the boats now in use on that river. I estimate the steamboat, when complete for the voyage, to cost $2,500, but say £1,000, and to keep it in perpetual repair, say, it will cost £100 per year, which boat transports 200 tons per year.

The interest of the money is	£60
The repairs	100
Wages of four men, say $400	150
Engineer, say	100
Provisions and necessaries, say	100
In all is	£510



COAL AND EMIGRANT ARKS AND RAFT.

"For transporting 200 tons, which reduces the price to less than 2s. 7d per hundred weight.

"To transport 200 tons, according to Dr. Flowers' estimate, amounts to £11,850 (provincial currency), which leaves a balance in favor of the steamboat of £11,340 for one boat only for one year, and at this day I presume that less than ten or fifteen boats would not do the business of that river."

REDUCTION OF FREIGHT CHARGES EFFECTED BY BARGES.

Before the use of steamboats became common on western waters, however, a considerable reduction in rates was effected in the movements between points where relatively large quantities of freight were concentrated. The extent and nature of these reductions is indicated by the following statement of Judge Burnett:—

"The improvement in the navigation of the west and her commercial operations was in the introduction of barges moved by sails, when the wind permitted, and at other times by oars and setting poles, as the state of water might require. These vessels were constructed to carry from fifty to a hundred tons. In the best seasons, if properly managed, they could make two trips between Cincinnati and New Orleans in a year. The increased quantity of cargo they carried reduced the price of freight, and enabled them to transport from New Orleans to Cincinnati *at from five to six dollars per hundred, which was below the average charge of carriage across the mountain.* From that time, most of the groceries and other important articles used in the (north-western) territory were brought up the river by these barges, and as *the price of freight was diminishing the quantity of produce shipped was proportionately increased.* The introduction of this mode of navigating the Ohio and Mississippi was an epoch in the history of the west. It was viewed as an improvement destined to advance both her commercial and agricultural interests."

EARLY SUCCESSFUL STEAMBOAT OPERATIONS.

THE ingenious and persistent efforts of John Fitch to secure the financial success of his steamboat inventions, had been so unfortunate in immediate results that a member of the American Philosophical Society, Mr. Benjamin H. Latrobe, in replying, on behalf of that society, to the inquiry of a society in Rotterdam, what improvements had been made in the construction of steam engines in America, said that shortly after the Revolution "a sort of mania began to prevail, which, indeed, has not yet entirely subsided, for impelling boats by steam engines," but he closed his communication with the announcement that he had never "heard of an instance verified by other testimony than that of the inventor, of a speedy and agreeable voyage having been performed in a steamboat of any construction;" but that "there are still many very respectable and ingenious men who consider the application of the steam engine to the purpose of navigation as highly important, and as very practicable, especially on the rapid waters of the Mississippi; and who would feel themselves almost offended at the expression of an opposite opinion. And, perhaps, some of the objections against it may be avoided. That founded on the expense and weight of the fuel may not, for some years, exist on the Mississippi, where there is a redundance of wood on the banks; but the cutting and loading will be almost as great an evil."

At that time practical and profitable steamboats were much nearer a tangible reality than the writer of this discouraging communication imagined them to be. The labors of the pioneers in this useful field of effort were about to produce a rich harvest. In 1804 Oliver Evans, one of the most skillful of the early inventors of the United States, who had a better appreciation of the efforts of Fitch and the companies with which he had been identified than most of his contemporaries, completed a mud-scow, or machine for cleaning out and deepening docks, which had in it a steam engine of the power of five horses. He created an extraordinary sensation in Philadelphia by successfully using this engine in propelling his scow over land as well as by water. His own description of this performance is as follows: "To show that both steam carriages and steamboats were practicable (with my steam engine), I first put wheels to it, and propelled it by the engine a mile and a half, and then into the Schuylkill, although its weight was equal to two hundred barrels of flour. I then fixed a paddle-wheel at the stern, and propelled it by the engine down the Schuylkill and up the Delaware, sixteen miles, leaving all the vessels that were under sail full half way behind me, the wind being ahead, although the application was so temporary as to produce great friction, and the flat most illy prepared for sailing done in the presence of thousands."

In 1804 another successful steamboat experiment was made on the Hudson by Colonel John Cox Stevens, who felt so much encouraged by the results that he applied his devices, in 1806, to a pirogue, 50 feet long, 12 wide, 7 deep, which attained considerable speed. He then commenced the construction of the Phœnix, a side-wheel steamer, so stoutly built that she was sent to Philadelphia from New York by sea, in 1808, and thus became the first vessel propelled by steam to brave the perils of the ocean.

ROBERT FULTON PUTS STEAMBOATING ON A FIRM BASIS.

The first decade of the nineteenth century also witnessed the complete demonstration of the practicability of steamboat navigation, and Robert Fulton is very honorably identified with this movement. He was much more fortunate than his predecessors and contemporaries in securing all the elements of success, which included the requisite financial support, familiarity with the mechanical devices of his predecessors, and the hope of profit created by the grant of the exclusive right of using steamboats for twenty years on all the waters within the territory or jurisdiction of New York. This right or privilege was vested in Robert R. Livingston in 1798, and when he became Minister to France he formed the acquaintance with Fulton which led to their continued combination of efforts until marked success was attained. The monopoly conferred prevented the use of the steamboat built by Col. Stevens on the waters of the Hudson, and thus gave to Fulton's early steamboats a prestige they might not have fully gained if free competition had been permitted.

But after making due allowance for all these circumstances the fact remains that Fulton was the first to put steamboating as a business on a substantial financial basis. The grant of the New York legislature required that steamboats should be constructed capable of performing journeys at the rate of four miles an hour. This was a common rate of speed for land travel on good roads, and we have heard of one instance in which it was the habit of a Revolutionary soldier, long after turnpikes had been constructed, to attempt to make that a uniform gait in private journeys. He carefully noted the milestones and his watch. If he traveled four miles in less than an hour his horse was immediately stopped and allowed a breathing spell until the allotted period had expired. It was, therefore, considered an immense success when the speed of nearly five miles an hour was steadily attained in the

FIRST IMPORTANT TRIP OF THE CLERMONT,

the first boat intended for real service which was constructed under the partnership arrangement existing between Fulton and Livingston. This voyage extended from New York to Albany and back to the starting point. It was made in September, 1807. Fulton's own account of it in a letter dated September 15th, 1807, written a few hours after the trip was finished, says:—

"I left New York on Monday at one o'clock, and arrived at Clermont, the seat of Chancellor Livingston, at one o'clock on Tuesday—time, twenty-four hours; distance, one hundred and ten miles. On Wednesday, I departed from the Chancellor's at nine in the morning, and arrived at Albany at five in the afternoon—distance, forty miles; time, eight hours. The run is one hundred and fifty miles in thirty-two hours, equal to near five miles an hour. On Thursday, at nine o'clock in the morning, I left Albany, and arrived at the Chancellor's at six in the evening. I started from thence at seven, and arrived at New York at four in the afternoon—time, thirty hours, space run through one hundred and fifty miles, equal to five miles an hour."

From that time the practicability of having boats propelled by steam was never doubted by intelligent men who were familiar with Fulton's achievements. Many improvements were subsequently made, and speed was so rapidly increased that soon more than thirteen miles was run in an hour. Fulton superintended the construction of a number of steamboats, including several used as ferry-boats in crossing the rivers which environ the city of New York, a steamboat intended to navigate the lower Mississippi, which was used by the American forces about the time of the battle of New Orleans, and the first steam vessel of war ever put to practical use.

THE FIRST STEAMBOAT RUN ON WESTERN WATERS

was the Enterprise, subsequently called the New Orleans, which originally was a keel-boat, constructed by the keel-boat builders at Marietta, but fitted up at Pittsburgh with an engine and a stern wheel, under an arrangement with Robert Fulton. It left Pittsburgh on its trial trip October 11th, 1811, and afterwards ran between New Orleans and Natchez until 1814, when it was wrecked. It was between 300 and 400 tons burden, and cost $40,000.

It was not until 1817 that steam navigation was fairly introduced upon the Mississippi and its tributaries. Previous to that year there were, according to one authority, 12 steamboats upon these waters, having an aggregate carrying capacity of 2,235 tons. This may have been an underestimate.

Morris Birkbeck, an English traveler, in a book printed in London in 1818, entitled Letters from Illinois, notes, under date of August 9th, 1817, from Princeton, Ind., the increasing facility of upward navigation of the Mississippi and Ohio rivers by steam, and copies from the log-book of the steamer Etna, in the Louisville Courier, which he had just received, in confirmation of an opinion that he had expressed at Cincinnati on the 22d day of June preceding, that "the upward navigation of these streams (the Ohio and Mississippi) is already coming under the control of steam, an invention which promises to be of incalculable importance to this new world."

The following is the "extract from the log-book of the steamboat Etna, de Hart, from New Orleans to Louisville:—"

1817, June 6th. Left New Orleans.

June 12th. Arrived at Natchez. Left 15th.

June 18th. Passed the barge Mary Ann, bound up, above the gulf.

June 19th. Passed the barge Cincinnati above the Yazoo river.

June 20th. Passed the barge General Washington below the Crow's Nest.

June 24th. In the morning, below the Arkansas, met the Franklin.

June 26th. Passed the steamboat Buffalo, Captain Sturges, bound up, thirty miles below the river St. Francis. At 3 P. M. met the steamboat Kentucky, seven days from the falls.

June 28th. Passed the steamboat Harriet above the Grand Cut-off, with a leaky boiler. One P. M. met the steamboat Washington, Captain Shreve, 30 miles below Chickasaw Bluffs, four days from the falls. Four P. M. met the steamboat Vesuvius, de Hart, 18 miles below the Bluffs, three days and a half from the falls.

July 1st. Passed the barge Independence, fifty-five days from New Orleans, above the Devil's Race Ground; also, passed a sloop barge.

July 6th. About New Madrid passed a sloop barge.

July 8th. In the Ohio, below the Three Sisters, passed the barge Expedition.

July 10th. Stopped and discharged cargo at Shawneetown.

July 11. Stopped and discharged cargo at Henderson.

July 13th. Passed the Triton Baum, in the mouth of Sinking creek, discharging cargo.

July 14th. At 4 P. M. passed sloop barge at Big Blue river. Arrived at Louisville.

The writer then goes on to say that "the average of speed against stream of a steam vessel heavily laden is about 60 miles a day. A considerable number of these vessels, I believe about 25, measuring from 50 to 400 tons burden, are now plying on these rivers, generally built at Pittsburgh, or their machinery prepared there."

EARLY STEAMBOAT FREIGHT CHARGES.

Much as the early steamboats did to increase the speed of travel and the rapidity with which merchandise was conveyed between different points, they did comparatively little for some years after they commenced running to materially reduce the cost of freight movements. This fact seems to be established by testimony sworn to, in 1836, by Jasper Lynch, in connection with a claim made by heirs of Robert Fulton for damages occasioned by the seizure of the steamboat Vesuvius, for the use of the Government at the time of the invasion of New Orleans, in 1814. Lynch was engaged in steamboating on the Mississippi for some years after 1816, and in the sworn statement referred to above he says:—

"On my arrival at New Orleans, in 1816, I found the following prices of freight in steamboats on the Mississippi, established, I believe, by the legislature of Louisiana, in 1812:—

From New Orleans to Louisville, 4½ cents per pound for heavy goods, and six cents for light; averaging five cents per pound, or per ton	$112 00
From New Orleans to Natchez, three-fourths of a cent per pound, or $1.50 per barrel; and the same rates were charged for all the intermediate landings—Donaldsonville 75 miles, Baton Rouge 120, &c., or per ton	15 00
From New Orleans to Louisville, passage	125 00
From New Orleans to Natchez	30 00
And half price for passage down.	

These rates continued uniform. I never received less, and they were not reduced until 1819."

PRIMITIVE LAND MOVEMENTS.

HOW THE HORSES HELPED THE INDIANS.

THE privations and labors imposed upon the Indians by their crude methods of overland transportation were so severe that the greatest physical boon they ever received from civilization was the horse. His importance was graphically described in the statement of an early explorer of Virginia that if she had "but horses and kine, and were inhabited with English, no realm in christendom were comparable to it." Traces of the anxiety of some of the tribes living near the Atlantic coast to obtain these valuable animals crop out in the reports of the colonial agents who visited them, but as a rule the eastern savages were too poor to buy horses, and they were so carefully guarded that they could not readily be stolen. From the stock of horses brought to Florida, Mexico, and California by the Spaniards a race of wild horses was gradually developed, and the readiness of the Indians of the south-western and north-western tribes to avail themselves of these equine aids shows how highly their powers were appreciated. The horse was to the land travel of the Indians as helpful as the canoe to their water wanderings. He could be used in the hunt, in war expeditions, and in journeys from point to point. He became as much of a familiar companion and household idol to many of the western tribes as he had been to the Arab. The superior horses were generally reserved for the use of the warriors, while the ponies best fitted for drudgery were used in dragging the tents, household equipage, fuel, and food from point to point, thus greatly diminishing the labors of the Indian women, and giving tangible indications of the origin of the name by which they were often called, of squaw ponies.

It is noticeable that no instructions were necessary to teach the Indians how to use horses. They acquired proficiency in this branch of civilization without the aid of government agents or other representatives of the white men, and even surmounted, in many instances, the increased difficulty of catching and training wild horses. As riders they perform feats which only the most daring of white equestrians would attempt. On the plains, when warriors were wounded, they were sometimes transported on rude stretchers, supported by two horses, a method which prevailed in European countries before carriages were introduced.

By obtaining horses the savages were placed upon an equality, so far as their requirements for transportation extended, with a large portion of the human race, as the principal land movements of many tribes and nations have been unaided by wheeled vehicles, and helped only by beasts of burden. But few, if any, of the tribes who formerly roamed over the territory embraced within the present limits of the United States were aided in moving persons and things by any animal before European immigration commenced. They had no horses. Dogs could scarcely have been utilized to any considerable extent as they are among the Esquimaux. The reindeer could not be pressed into service as they were in northern Europe, and the list of indigenous animals embraced neither the lama, the camel, the elephant, or an available substitute. Except in the existence of an unusually large number of streams navigable for light craft, and of a remarkable contiguity between the points from which great river systems converged, the aborigines of this country were unfavorably situated with reference to natural aids to transportation.

PRACTICAL EFFICIENCY OF HUMAN BURDEN BEARERS.

All heavy articles which could not be moved on water channels had generally to be carried, if moved at all, on the backs of those who wished to use them. A large portion of the human race has always been subjected to this sort of privation. It practically results in transforming them, for a number of purposes, into beasts of burden, and this is the normal condition of a considerable proportion of the native Mexicans at the present day. While the squaws were expected to perform a full share of this sort of work, and had burthen straps to assist them, the male Indians were sometimes pressed into the same service.

What male savages are capable of doing as burden bearers is shown by a report of a recent exploration of Alaska, which states that "some 6,500 pounds were 'packed' down the mountain by less than sixty-five Indians. . . . The whites say that it was almost impossible to retain their footing as they wended their way around the sides of the steep mountains. A misstep would have sent the unfortunate one eight to twelve hundred feet in the cañons below; but notwithstanding that the whites were so cautious their Indian allies went along with apparent ease—boys not yet eighteen years of age carrying 65 pounds, and adults from 100 to 130 pounds. The Indians, without exception, carried their entire load by a band around the forehead, and never attempted to steady the load or allow its weight to fall upon the shoulders."

Theoretical calculations and practical experiments show that the greatest amount of efficient work can be extracted from the average man who serves as a burden bearer, by giving him a load of 119 pounds, which he can move eleven miles a day. At this rate it would require more than a day and a half to move a net ton one mile.

It will probably never be known how long the Indians lived here under the disadvantages arising from the absence of beasts of burden, but this deprivation probably had a material influence in prolonging the savage or hunter state of development. There was no inducement to surplus production of any important description, because it could not be transported for any considerable distance except at a cost far exceeding its trade value. Any rude forms of commerce that may have existed must have been mainly in articles of very light weight, such as wampum belts, or the shells out of which they were made, or peculiarly precious furs, robes, trinkets, weapons, and products. In a region of such wide extent that it was bounded by the two great oceans, great lakes on the northward, and a great gulf on the south, there was not a horse or other useful beast of burden, not a single wheeled vehicle, not a road (the only substitute being narrow trails), not an artificial water-course, and no mode of land travel except on foot or being carried by fellow human beings.

It is hard to conceive of a lower state of transportation facilities than that which existed here, in all matters except those connected with primitive water movements, and barbarism, privation, frequent wars about hunting and fishing grounds, because they furnished the chief means of subsistence, famines when supplies fell short, and abandonment or destruction of the weak, aged, and infirm when they were unable to accompany a tribe in an overland journey, were natural outgrowths of the inferior methods of savage locomotion. The social and industrial state arising from or corresponding with this lack of the great mainspring to productive labor is eloquently described by Bancroft: "And man, the occupant of the soil, was wild as the savage scene, in harmony with the rude nature by which he was surrounded, a vagrant over the continent, in constant warfare with his fellow-man; the bark of the birch his canoe; strings of shells his ornaments, his record, and his coin; the roots of the forest among his resources for food; his knowledge in architecture surpassed both in strength and durability by the skill of the beaver; bended saplings the beams of his house, the branches and rind of trees its roof; drifts of forest leaves his couch; mats of bulrushes his protection against the winter's cold; his religion the adoration of nature; his morals the promptings of undisciplined instinct; disputing with wolves and bears the lordship of the soil, and dividing with the squirrels the wild fruits with which the universal woodlands abounded."

THE PACK-HORSE OR HORSEBACK ERA.

THE use of beasts of burden was confined chiefly to utilizing them as carriers of persons or property, in a large number of the districts of the United States, during a protracted period after the first settlements were founded. This state of things arose from the lack of good roads and convenient vehicles, and in some quarters of the country the old customs are still partially followed to a considerable extent. For personal movements overland horseback riding, aside from walking, was so nearly the universal resort up to the beginning of the nineteenth century, that it was only a few of the wealthy families that kept carriages, and stage lines had only been established on a few of the most important routes. The nineteenth century was well advanced before it ceased to be a common practice in many districts for young women in tolerably fair circumstances to own a side-saddle, as they were expected to be skillful riders and to make social journeys on horseback. In the northern states the use of carriages became general at an earlier period than in the southern states, and a marked difference in the extent to which skill as equestrians was common among the people of both sections was noticed in connection with the first organization of cavalry regiments, after the civil war commenced in 1861. At earlier periods the transportation of freight was also conducted, to a considerable extent, on the backs of horses or other animals, and in a few of the remote or wild interior districts this practice has been continued.

The inhabitants of some of the old-world countries, after being familiarized with the use of such effective carriers as camels and elephants, seem to have little or no desire for further advancement, and to have continued to move themselves and their property on the backs of these animals for many centuries. But the incessant thirst for change and progress which has animated the main body of the American people has rendered the complete dominance of a pack-horse or horseback era of relatively short duration in nearly all districts after they attracted a considerable population. Pack-horse movements between such districts and comparatively distant settlements as could not be conveniently reached by water routes were continued, however, for a lengthy period; and the necessity for employing pack animals was specially urgent in cases where the proposed journeys required the crossing of steep and lengthy mountain regions. In maintaining communication between the early forts and settlements west of the Allegheny mountains and the Atlantic coast pack-horses were at one time extensively employed, and they have also been used in a number of the movements made to or amidst the great mountain chains west of the Missouri and near the Pacific coast.

PACK-HORSES USED IN THE BRADDOCK EXPEDITION.

The events connected with attempts to send the ill-fated Braddock expedition to western Pennsylvania, in 1755, illustrate the transportation systems and facilities then prevailing. There was no road on which wagons could be moved for a large part of the distance nearest Fort Duquesne. An Indian trail existed in south-western Pennsylvania, over which traders had long conducted communication with the Indians, carrying their goods on pack-horses, but no attempt to enlarge the western portion of the trail, so that it could be used by wheeled vehicles, had been made. Two of General Braddock's greatest difficulties were, first, to induce the Pennsylvania assembly to make a wagon road, although the work consisted mainly in cutting down a sufficient number of trees to create a narrow passage, and, second, to obtain one hundred and fifty wagons, the number considered necessary. Strenuous exertions, and practical exemplifications of the fact that British officers did not exhaust their vocabulary when "the army swore terribly in Flanders," finally secured the cutting of the road. General Braddock had by this time reached Frederick, Md., but when he was visited there by Benjamin Franklin returns of available wagons were brought in, and, to the surprise and mortification of the British officers, they found that only twenty-five could be procured, and some of these were not in serviceable condition. In the midst of the embarrassment arising from this poor return, Dr. Franklin relates that he happened to say he thought it was a pity the two regiments of British troops "had not been landed in Philadelphia, as in that country about every farmer had his wagon." General Braddock then earnestly entreated Dr. Franklin to undertake the task of providing them, which he successfully accomplished by the issue of the ingenious advertisement and address which have a high rank in the list of his famous literary productions.

In this advertisement he states that one hundred and fifty wagons, with four horses to each wagon, and *fifteen hundred saddle or pack-horses* are wanted. In defining the terms he says that "there shall be paid for each wagon, with four good horses and a driver, fifteen shillings per diem; and for each able horse with a pack-saddle, or other saddle and furniture, two shillings per diem; and for each able horse without a saddle eighteen pence per diem." The wagons and teams were to be valued, and in case of their loss or destruction, in warlike operations, the owners were to be fairly compensated. This stipulation subsequently caused Dr. Franklin much anxiety, as many of the wagons and teams were either captured by the French and Indians after the disastrous battle at Braddock's Field, or lost during the retreat, and some of the owners commenced suits against him. He says: "General Shirley at length relieved me from this terrible situation by appointing commissioners to examine the claims and ordering payment. They amounted to near twenty thousand pounds, which to pay would have ruined me." (The sums referred to are probably Pennsylvania currency, the pound of which was equal to $2.66⅔ of the present money.)

In the address issued relative to wagons and horses, their service is described as "light and easy, for the army will scarce march above twelve miles per day, and the wagons and baggage horses, as they carry those things that are absolutely necessary to the welfare of the army, must march with the army, and no faster."

An indication of the weight horses of superior quality were expected to carry is furnished by the statement that twenty horses were selected as presents for officers of the British army, at Dr. Franklin's suggestion, and each sent forward to the camp loaded with a parcel containing the following articles: Six pounds loaf sugar; 6 pounds Muscovado sugar; 1 pound green tea; 1 pound Bohea tea; 6 pounds ground coffee; 6 pounds chocolate; one-half chest best white biscuit; one-half pound pepper; 1 quart white vinegar; 1 Gloucester cheese; 1 keg containing 20 pounds good butter; 2 dozen old Madeira wine; 2 gallons Jamaica spirits; 1 bottle flour of mustard; 2 well-cured hams; one-half dozen dried tongues; 6 pounds rice; 6 pounds raisins.

PACK-HORSE TRADE CONDUCTED OVER THE ALLEGHENY MOUNTAINS.

For a very considerable period after the Braddock expedition, the pack-horse system continued to furnish the only available method of transportation to and from the early settlements in south-western Pennsylvania and western Virginia. The principal pioneer movements in south-western Pennsylvania commenced soon after 1764. Braddock's trail, as it was called, was the favorite route for crossing the Allegheny mountains, but some movements were made by way of Bedford and Fort Ligonier, which was the military road to Pittsburgh. All effects and household furniture were carried on horses furnished with pack-saddles. For a number of years after these settlements were well established this primitive and expensive method was still followed. In Doddridge's notes on the early settlements of western Pennsylvania and Virginia he says:—

"The acquisition of the indispensable articles of salt, iron, steel, and castings presented great difficulties to the first settlers of the western country. They had no stores of any kind, no salt, iron, nor iron works; nor had they money to make purchases where these articles could be obtained. Peltry and furs were their only resources before they had time to raise cattle and horses for sale in the Atlantic states. Every family collected what peltry and fur they could obtain throughout the year for the purpose of sending them over the mountains for barter. In the fall of the year, after seeding time, every family formed an association with some of their neighbors, for starting the little caravan. A master driver was to be selected from among them, who was to be assisted by one or more young men and sometimes a boy or two. The horses were fitted out with pack-saddles, to the latter part of which was fastened a pair of hobbles made of hickory withs,—a bell and collar ornamented their necks. The bags provided for the conveyance of the salt were filled with feed for the horses; on the journey a part of this feed was left at convenient stages on the way down, to support the return of the caravan. Large wallets well-filled with bread, jerk, boiled ham, and cheese furnished provision for the drivers. At night, after feeding, the horses, whether put in pasture or turned out into the woods, were hobbled and the bells were opened. The barter for salt and iron was made first at Baltimore; Frederick, Hagerstown, Oldtown, and Fort Cumberland, in succession, became the place of exchange. Each horse carried two bushels of alum salt, weighing eighty-four pounds to the bushel. This, to be sure, was not a heavy load for the horses, but it was enough, considering the scanty subsistence allowed them on the journey. The common price of a bushel of alum salt, at an early period, was a good cow and calf."

HOW WESTERN WANTS WERE FIRST SUPPLIED.

In Monnett's History of the Valley of the Mississippi he gives some further details than those furnished in Doddridge's Notes of the methods employed by the settlers of western Virginia and south-western Pennsylvania, about and shortly previous to the Revolution, to secure an exchange of their surplus products for salt, iron, utensils, and implements. He states that "it was customary in the western settlements of Pennsylvania and Virginia, from the Kanawha to the Allegheny river, every fall, for each little neighborhood of a few families to dispatch a 'caravan' to the settlements east of the mountains. . . . It consisted of a master, two or three young men, and one or two boys, a few horses, with pack-saddles on their backs, stuffed bells on their necks, and a pair of hickory-withe hobbles attached to each pack-saddle. On each pack-saddle was secured a bag of shelled corn for provender on the way, to be deposited at convenient distances for the return route. A large wallet, well filled with bread, jerked bear's meat, or boiled ham and cheese, contained the provision for the drivers. Thus equipped, the cavalcade set out from the wilderness east of the Ohio for Baltimore, Frederick, Hagerstown, or Oldtown, in early times, and subsequently to Fort Cumberland and Manchester.

"As the places successively, in the order of their names, became the marts of the western trade, the whole amount of hides and peltries, ginseng, snake-root, and bear's grease were exchanged or bartered for salt, nails, and other articles of iron, and occasionally for a few pewter plates and dishes for the table. The bartering for the settlement being finished, the caravan was ready for its retrograde march. Each horse without a rider carried two bushels of salt, weighing eighty-four pounds to the bushel, besides a few light articles superadded. The caravan route from the Ohio river to Frederick crossed the stupendous ranges of the Allegheny mountains as they rise, mountain behind mountain, in the distant prospect. The path, *scarcely two feet wide*, and traveled by horses in single file, roamed over hill and dale, through mountain defile, over craggy steeps, beneath impending rocks, and around points of dizzy heights, where one false step might hurl horse and rider into the abyss below. To prevent such accidents, the bulky baggage was removed in passing the dangerous defiles, to secure the horse from being thrown from his scanty foothold. This route, selected by experienced woodsmen, differed but little from that selected for turnpikes and railroads by professed engineers at a much later day. . . . The order for the march, going and returning, was the same. The horses, with their packs, were marched along in single file, the foremost led by the leader of the caravan, while each successive horse was tethered to the pack-saddle of the horse before him. A driver followed behind, to keep an eye upon the proper adjustment of the packs, and to urge on any horse that was disposed to lag. In this way two men could manage a caravan of ten or fifteen horses, each carrying about two hundred pounds' burden. When night came, a temporary camp and a camp-fire protected the weary travelers, while the horses, released of their burdens, with hobbles on their feet, and their bell-clappers loosed, were turned loose to graze near the camp."

MORE MODERN PACK-HORSE MOVEMENTS.

At a later stage the pack-horse system was continued over nearly the same route, but from eastern terminal points in Pennsylvania, by common carrier organizations. Rupp's history of Cumberland county, Pennsylvania, published in 1848, says:—

"The modes of transporting or conveying produce and other articles of commerce have been, like the highways, thoroughfares, or public roads, much improved within the memory of many now living west of the Susquehanna. Sixty or seventy years ago five hundred pack-horses had been at one time in Carlisle, going thence to Shippensburg, Fort Loudon, and further westward, loaded with merchandise, also salt, iron, &c. The pack-horses used to carry bars of iron on their backs, crooked over and around their bodies; barrels or kegs were hung on each side of these. Colonel Snyder, of Chambersburg, in a conversation with the writer in August, 1845, said that he cleared many a day from \$6 to \$8 in crooking or bending iron and shoeing horses for western carriers at the time he was carrying on a blacksmith shop in the town of Chambersburg. The pack-horses were generally led in divisions of 12 or 15 horses, carrying about two hundred weight each, all going single file and being managed by two men, one going before as the leader and the other at the tail to see after the safety of the packs; when the bridle road passed along declivities or over hills, the path was in some places washed out so deep that the packs or burdens came in contact with the ground or other impeding obstacles, and were frequently displaced. However, as the carriers usually traveled in companies, the packs were soon adjusted, and no great delay occasioned. The pack horses were generally furnished with bells, which were kept from ringing during the day drive, but were let loose at night when the horses were set free and permitted to feed and browse. The bells were intended as guides to indicate their whereabouts in the morning. When wagons were first introduced, the carriers considered that mode of transportation an invasion of their rights; their indignation was more excited and they manifested greater rancor than did the regular teamsters when the line of single teams was started some thirty years ago."

PACK-ANIMALS IN MOUNTAINS.

In Captain Marcy's Prairie Traveler he says that "with a train of pack-animals, properly organized and equipped, a party may travel with much comfort and celerity. It is enabled to take short cuts, and move over the country in almost any direction without regard to roads. Mountains and broken ground may easily be traversed, and exemption is gained from many of the troubles and detentions attendant upon the transit of cumbersome wagon trains. One of the most essential requisites to the outfit of a pack-train is a good pack-saddle." He then describes and gives an illustration of a pack-saddle manufactured in St. Louis, which he found very serviceable. He says: "It is open at the top, with a light, compact, and strong tree, which fits the animal's back well, and is covered with raw-hide, put on green, and drawn tight by the contraction in drying. It has a leathern breast strap, breeching, and lash strap, with a broad hair girth fastened in the Mexican fashion."

Of the loads that can be carried he says that "one hundred and twenty-five pounds is a sufficient load for a mule on a long journey." He states, however, that the Spanish Mexicans are "cruel masters, having no mercy upon their beasts, and it is no uncommon thing for them to load their mules with the enormous burden of 300 or 400 pounds."

In a note on this subject, Mr. Richard F. Burton, a celebrated British traveler, says: "For long journeys a strong mule should not carry more than 120 pounds, and asses about one-half."

In reference to comparatively recent pack-horse movements, Hall's Guide to the Great West, published in 1865, says that New Mexico furnished the greater part of the mules used by the overland emigrants to California; that they were of very large size, worth about \$100 each, and would carry from 400 to 500 pounds up the mountain with apparent ease.

In the Indian substitute for the pack-horse system, designated a "travail," formed by the crossing of poles, which are generally the poles of a tent or tepee, the poles usually rest on a pack-saddle or pad, which a breast strap keeps from slipping back.

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has almost invariably used pack-horses extensively, inasmuch as the earliest form of trade at nearly all typical points in the United States has consisted in the exchange of liquor, arms, ammunition, kettles, and trinkets for furs, skins, or robes. As the Indians receded, or were driven back from the sea-coast or prominent settlements, it became necessary that traders should push their way further and further into the interior, and in seeking outposts near the hunting grounds that were constantly becoming more and more distant from the seaboard, the pack-horse furnished indispensable aid to those who wished to carry with them the articles coveted by the savages, and to take back the only available products of barbaric industry.

HEAVY COST OF PACK-HORSE MOVEMENTS.

Up to a recent date nearly all the interior transportation movements in Mexico were conducted on donkeys or pack-mules. The customary charge was at the rate of one cent a pound for twenty leagues.

The system is necessarily so expensive that it practically prohibits the transportation over considerable distances of all articles that are not of great value or prime necessity.

In Harper's Monthly for September, 1877, Edward Howland says that in 1784 the cost of transportation by pack-horses from Philadelphia to Erie was \$249 a ton.

COMMON OR COUNTRY ROADS.

THE methods of transportation heretofore described were nearly all of a character that received little or no aid from the concerted action of communities obtained by the exercise of governmental authority. As material advances require such aid, for the improvement of the route over which vessels or vehicles are moved, we shall next consider the assistance of this description that was first rendered—the opening, construction, and repairing of country or common roads.

EARLY COLONIAL LAWS RELATING TO ROADS.

The basis of much of the early colonial legislation relating to roads was probably found in an act of the English Parliament, passed during the reign of Henry VIII, which allotted to parishes the care of the roads passing through them, appointed road surveyors, and provided for enforcing the assistance of laborers, and levying a road tax on land-holders. But the apparent necessity for superior long roads was, during a protracted period, as scant as the resources available for constructing them. The ocean furnished means of access to Europe and the West Indies, as well as a channel of communication between the different colonies. Long journeys from northern to southern points could be more conveniently made in vessels than by land, and as to western movements of considerable length, they were for many years confined chiefly to operations connected with trading with the Indians, a large proportion of which was monopolized by the French, on account of their control of the St. Lawrence, the lakes, and, to a large extent, the Ohio and upper Mississippi, previous to the overthrow of their authority over Canada.

The earliest references of importance to highways in the records of the colony of the Massachusetts Bay in New England are embraced in a preamble and order adopted in 1639, which reads as follows: "Whereas the highways in this jurisdiction have not been laid out with such conveniency for travelers as were fit, nor as was intended by this court, but that in some places they are felt too straight, and in other places travelers are forced to go far about, it is therefore, ordered, that all highways shall be laid out before the next general court, so as may be with most ease and safety for travelers; and for this end every town shall chose two or three men, who shall join with two or three of the next town, and these shall have power to lay out the highways in each town where they may be most convenient; and those which are so deputed shall have power to lay out the highways where they may be most convenient, notwithstanding any man's propriety, or any corne ground, so as it occasion not the pulling down of any man's house, or laying open any garden or orchard; and in common grounds, or where the soil is wet or miry, they shall lay out the ways the wider, as six, or eight, or ten rods, or more in common grounds."

Additional clauses provide for the payment of damages in cases of extraordinary injury to improved property, and the order concludes with the statement that "it is not intended that any person shall be charged with the repairing of the highways in his own land."

The law relating to roads in force in Pennsylvania before that province was granted to William Penn was part of the system established for the government of New York in 1664. It intermingled provisions for road-making with all other public work, and is as follows: "In all public works for the safety and defence of the government, or the necessary conveniences of bridges, highways, and common passengers, the governor or deputy governor and council shall send warrants to any justice, and the justices to the constable of the next town, or any other town within that jurisdiction, to send so many laborers and artificers as the warrant shall direct, which the constable and two others or more of the overseers shall forthwith execute, and the constable and overseers shall have power to give such wages as they shall judge the work to deserve, provided that no ordinary laborer shall be compelled to work from home above one week together. No man shall be compelled to do any public work or service unless the press (impressment) be grounded upon some known law of this government, or an act of the governor and council signifying the necessity thereof, in both which cases a reasonable allowance shall be made."

CONTRAST BETWEEN THE COLONIAL AND ROMAN ROAD SYSTEMS.

Under these systems very little work was done, partly because the Indian trails furnished the principal facilities needed for the limited amount of land travel attempted, and partly on account of the difficulty of providing for the payment of the cost of any considerable amount of road-making. It was the Roman method modified by humane considerations and regard for popular rights. It claimed the privilege of a Cæsar to lay out roads and to enforce their construction, but it limited the amount of work which any individual could be asked to perform; and by promising that he should always be paid for his labor, raised questions of taxation which English rulers generally found very troublesome. The Romans, following in the footsteps of the Carthagenians, were bothered by no such scruples. They built many roads as military necessities, and peremptorily demanded all the requisite aid from the people of subjugated provinces. Their public or high-roads were called consular roads, and for the making and repair of these thoroughfares the necessary cost was levied upon the owners of the lands through which they passed. To enforce this requirement inscriptions were erected along the roadside, which showed the divisions of the road, the names of the land-holders, the extent of their possessions, and the duty to be levied upon them.

Few, if any, good modern roads have been built anywhere, except under a system analogous to that of the Romans, unless unusual outlays of general or local governments for specific purposes were authorized, or the commercial principle was invoked by giving to turnpike, plank-road, and bridge companies the right to demand tolls.

MODIFICATIONS OF COLONIAL SYSTEMS.

In the road-making legislation of Pennsylvania, it is noticeable that dissatisfaction with the inefficiency of the various methods tried crops out in occasional changes.

The Duke of York's law, quoted above, was modified, in 1678, by an order of the court at Upland "that every person should within the space of two months, as far as his land reaches, make good and passable ways from neighbor to neighbor, with bridges where it needs, to the end that neighbors on occasion may come together,—those neglecting to forfeit twenty-five guilders."

The primitive nature of the roads contemplated, is indicated by an order made a few months later in the court at New Castle, giving the following directions: "The highways to be cleared as followeth, viz., the way to be made clear of standing and lying trees, at least ten feet broad; all stumps and shrubs to be cut close by the ground. The trees marked yearly on both sides—sufficient bridges to be made and kept over all marshy, swampy, and difficult dirty places, and whatever else shall be thought more necessary about the highways aforesaid."

Under Penn's administration the first control of roads was by the courts, which appointed overseers and fence viewers, the grand jury laying out the roads; in 1692 the control of roads was given to the townships. In 1700 a revision of pre-existing laws was made, and an act passed which gave the regulation of county roads to county justices, and the king's highway and public roads to the Governor and council. The different counties were directed to provide railed bridges over streams at their own expense and to appoint overseers of highways and viewers of fences.

In many northern sections of the country a condition of things prevailed for many years analogous to that attributed to New Brunswick about the time of the Revolution by Cobbett: "There were no roads. Communication between the settlements was conducted over streams and rivers, in summer in canoes, and in winter in sleighs."

In a large portion of the south bridle paths, many of which were originally Indian trails, formed the main avenues of local travel during all the early decades of the nineteenth century and in some sections the systems of road-making and repairing deteriorated after the war. There are still said to be some of the mountain counties of southern states, which have been inhabited for many years, in which no roads passable with wheeled vehicles have ever been made.

VARIATIONS IN THE CONDITION OF ROADS IN DIFFERENT DISTRICTS.

Theoretically and legally there was relatively good provision for road-making in some of the colonies, but how far such regulations were practically carried out depended, in a large degree, upon the prevalent disposition of each particular district or county. One of the roads authorized by the provincial government of Pennsylvania encountered such strong local antagonism that it was not completed in more than a hundred years. The roads of different states and subdivisions of each of the states vary greatly at the present day in their completeness, and there were similar variations in the degree of energy and skill displayed in the primitive work of expanding the Indian trails, creating new roads, and providing facilities for crossing deep streams.

THE GENERAL CONDITION OF TRANSPORTATION FACILITIES up to the time of the Revolution may be summarized in the statement that over the main portion of the territory now belonging to the United States no improvement whatever had been effected except in the addition of the horse to the list of aids that might possibly be obtained; that in all important and thickly-settled portions of the country a marked improvement in available water craft was secured by the use of ships and the gradual or partial substitution of batteaux and boats of various descriptions for canoes; and that a few sections had tolerably fair common roads. Permanent bridges over streams of considerable size were wholly unknown. The best substitute, at points of greatest importance, such as the Schuylkill at Philadelphia, were floating bridges, sustained by boats. These structures are of great antiquity, and, although only used generally for facilitating military operations, they were also adopted as bridges over rivers at or near some of the important European towns. Land travel was almost universally on horseback. The present century was well advanced before traveling in carriages became at all common, ladies as well as gentlemen making all their ordinary journeys on horseback or in heavy farm wagons.

Americans were too practical and too ready to see that a horse could pull much more freight than he could carry, to fail to appreciate the importance of wagons, but much as they desired the construction of roads, the use of pack-horses was necessary during a protracted period, on long routes, especially on those leading through mountainous districts, and notably the route between Harrisburg and Pittsburgh, after the commercial requirements of the latter place became of sufficient importance to require the maintenance of methodical transportation connections with the seaboard.

THE DIFFICULTY OF USING THE ROADS OF THE LAST CENTURY during unfavorable seasons, is indicated by the fact that when members of the Pennsylvania assembly were reproached by British authorities for not meeting promptly to make provision for wars in which their own constituents were deeply interested, one of their excuses was that the roads were so impassable that travel to the capital of the province, even on horseback, was impossible.

Nevertheless the importance of roads was keenly recognized by some of the leading minds of the young colonies. They appreciated the significance of the Roman maxim that "the first step in civilization was to make roads," and they lacked the power, rather than the will, to provide a complete system of inland highways. They had to contend with the general ignorance of the era, in reference to the best methods to be employed, the indifference or hostility of some landholders who did not wish to lose an inch of the soil they had acquired on cheap and easy terms, and above all with the scarcity of labor and capital available for road making.

BAD ROADS IN THE OLD WORLD AS WELL AS THE NEW WORLD.

The progress of the American colonies in making roads was so slow during the seventeenth and eighteenth centuries that the small amount of work done in this direction would be a just matter of reproach if due regard were not paid to the peculiarities of their industrial, political, and commercial position, and to the bad condition of the roads of most of the European countries from which they had emigrated. At the time of the Revolution there was not a good road of considerable length in any part of this country, and an American work on road-making, published in 1847, begins its preface with the declaration that "the common roads of the United States are inferior to those of any other civilized country." There are, even at the present time, many districts to which this criticism could be justly applied, notwithstanding the fact that amid the superabundance of bad and indifferent roads, some counties, districts, and states possess creditable highways. Extensive sections have made such slight expenditures for overcoming natural obstacles that when climatic conditions are unusually unfavorable it is a common thing for the forwarding of large quantities of agricultural staples to be delayed on account of the difficulty of hauling them over the short distance between the points of production and adjacent stations.

Few of the early colonists could have had a clear conception of what a good road was. Earnest attempts to construct numerous turnpikes in England were not made until the latter half of the eighteenth century, and it was during the reign of Charles II, in 1663, that the first act was passed authorizing the establishment of a toll, as a compensation for the expenditure required to construct a good highway. This law was not of general application, being a local measure, operative only in three English counties, and the new system met with so much antagonism that laws soon became necessary for the punishment of travelers who evaded or refused to pay toll, and of rioters who pulled down and destroyed turnpike gates.

A description of a journey from Glasgow to London, made in 1739, by two persons on horseback, states that they found "no turnpike until they arrived at Grantham, within 110 miles of London. Up to that point they traveled on a narrow causeway with an unmade soft road on each side of it. They occasionally met with strings of pack-horses, from thirty to forty in a gang, carrying goods. The leading horse of the troop carried a bell, to warn passengers coming in an opposite direction; and the passengers were then compelled to make way for them, and pass into the road side, since the causeway did not afford room for both."

Before the dawn of the nineteenth century there were few sections of the colonies in which the methods were any better, and many sections in which they were infinitely worse than the contemporaneous Scotch and English facilities. In describing them a modern English writer says that "it is scarcely a century since there was nothing deserving the name of a road in any of the great thoroughfares of Scotland. The whole inland trade of that country was carried on by means of pack-horses. They forded the different rivers and streams. The roads were often impassable in low and wet grounds. When Lord Herward was sent, in 1760, from Ayrshire to the college at Edinburgh, the road was in such a state that servants were frequently sent forward with poles to sound the depths of the mosses and bogs which lay in their way. The mail was regularly dispatched between Edinburgh and London, on horseback, and went in the course of five or six days; but so limited was the communication between the two capitals, that during the rebellion of 1745, when an order was sent from London to open all the letters in the post-office, with the view of detecting treasonable correspondence, there were not, in all, above twenty letters in the London bag. Between 1750 and 1760 a coach traveled from London to Edinburgh in thirteen days. Subsequently the London mail made the journey in forty-three hours and a half. The original coach between Edinburgh and Glasgow, which commenced running in 1765, occupied twelve hours on the road. A swifter vehicle was next introduced, which, on account of its great velocity, was called The Fly. It made the journey between Edinburgh and Glasgow in ten hours. Subsequently mail coaches made this journey, regularly, in five hours. Robertson, in his rural recollections, says that the common carrier from Selkirk to Edinburgh, thirty-eight miles distance, took two weeks for his journey between the two towns, going and returning. This road was then particularly dangerous and fatiguing, owing to steepness of hills, impassable bogs, and streams."

DEFECTIVE AMERICAN ROADS.

THE road-making of the colonial era was necessarily limited in extent and strongly marked by local characteristics. There was no powerful and sympathetic central authority to map out great through routes, and provide ways and means for constructing them, and it was only under such or similar conditions that the Romans had built the superior highways which gave rise to the saying that all roads lead to Rome. So far as the British government could influence the subject while the colonial system existed, it preferred to perpetuate commercial disseveration, so that all trade might be monopolized by its own merchants and manufacturers, as far as possible, and a cordial union of the people of the thirteen colonies be prevented.

INDIAN TRAILS

formed the only paths by which many of the early colonists reached the lands they subsequently cultivated, and the work of constructing new roads or widening trails went on very slowly.

In some sections the custom grew up of designating roads which were not passable for wheeled vehicles as "horse-ways." In south-western Pennsylvania much opposition was manifested to the widening of these horse-ways or bridle paths by the owners of pack-horses, who foresaw that the creation of highways broad enough to be used by wagons would lead to the loss of their occupation. Their interests had gradually been developed into considerable proportions, and they naturally dreaded the progressive movement by which it was practically destroyed. Regular pack-horse enterprises had been organized at Lancaster, Harrisburg, Shippensburg, Bedford, Redstone, and Fort Pitt. One proprietor at Harris' Ferry, in 1772, employed nearly two hundred horses and mules, and more than half that number of men.

LAND ROUTES BETWEEN SEABOARD CITIES.

The natural counterpart of the inferior accommodations for traveling in Scotland, and between Edinburgh and London, existing during a large portion of the last century, was to be found on the roads between Philadelphia and New York. Burlington, New Jersey, was for a long time a place of considerable consequence because land movements through New Jersey converged at that point, and from Burlington water craft of various classes furnished means of communication with Philadelphia. In 1707 the New Jersey assembly, in enumerating grievances to the colonial governor, complained that patents had been granted to individuals to transport goods on the road from Burlington to Amboy, which was one of the two highways connecting Philadelphia and New York. The governor, in reply, defined the nature of the monopoly complained of, and the state of internal commerce at that period, by saying that great difficulty had been experienced by those who wished to have goods carried over the road, and the new order of things he described as follows: "At present, everybody is sure, *once a fortnight*, to have an opportunity of sending any quantity of goods, great or small, at reasonable rates, without being in danger of imposition; and the sending of this wagon is so far from being a grievance or a monopoly, *that by this means, and no other*, a trade has been carried on between Philadelphia, Burlington, Amboy, and New York, which was never known before, and in *all probability never would have been.*" A few years later Governor Cornbury, who was the author of this statement, was recalled, and soon after that event the road was again opened to competition.

COLONIAL POSTAL ROUTES.

Inland mail communications corresponded in tardiness with travel.

In 1673 the first post rider between New York and Boston made a trip in three weeks.

In 1692 Thomas Neale was appointed Postmaster-General of Virginia and other parts of North America, but this appointment led to no results of importance. The failure is attributed, by a contemporaneous historian, to "the dispersed condition of the inhabitants."

In 1695 letters might be forwarded eight times a year from the Potomac to Philadelphia.

In 1710 Parliament passed "an act for establishing a general post-office for all her majesty's dominions." It provided for one chief letter office in New York, and other chief offices at convenient places. A line of posts was established, extending from Piscataqua to Philadelphia, and a few years later it was extended southward to Williamsburg, in Virginia, with the understanding that the post should "leave Philadelphia for the South as often as letters enough were lodged to pay the expense." Communication between Williamsburg and the Carolinas, which were established a few years later, were still more irregular.

In 1717 advices from Boston to Williamsburg, in Virginia, were completed in four weeks, from March to December, and in double that time in the other four months of the year.

About 1720 the post set out from Philadelphia every Friday, left letters at Burlington and Perth Amboy, and arrived at New York on Sunday night, leaving there Monday morning on its peregrinations eastward.

In 1722 a Philadelphia paper states that "the New York post was three days behind his time, and not yet arrived."

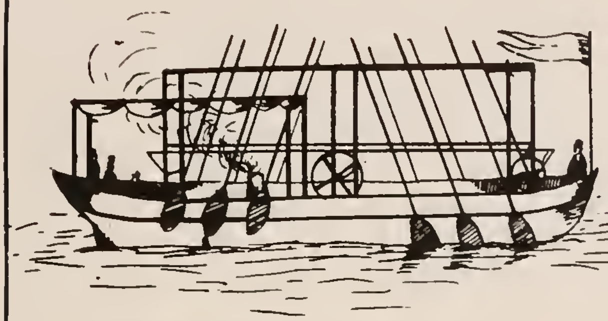
In 1729 the mail between the two cities went once a week in summer and once a fortnight in winter, and this continued until 1754, when Dr. Franklin became superintendent, and improved the colonial postal accommodations materially. In October of that year notice was given that until Christmas the post would leave the two cities three times a week, at 8 o'clock A. M., and arrive the next day at about 5 o'clock P. M., making thirty-three hours. After Christmas it left each city only twice a week. In 1764, if weather permitted, the mails were to leave every alternate day, and make the journey in less than twenty-four hours.

Dr. Franklin continued to be Postmaster-General for America till 1774. A year later, in 1775, the Continental Congress resolved that a Postmaster-General be appointed for the united colonies, who should establish his office at Philadelphia, where the Congress was to hold its sessions, and described the service contemplated in a resolution, which requires "that a line of posts be appointed, under the direction of the Postmaster-General, from Falmouth, in New England, to Savannah, in Georgia, with as many cross posts as he shall think fit."

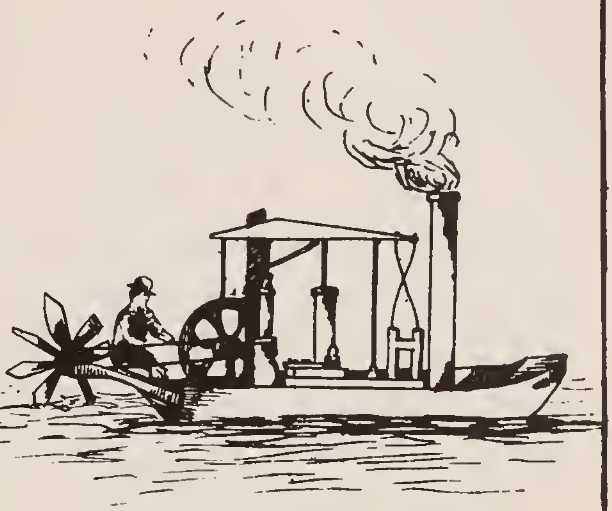
In 1790, seven years after the close of the Revolutionary War, the number of post-offices in the United States was only seventy-five; the aggregate length of the post-roads, only 1,875 miles; the amount paid for the transportation of the mails, $22,081; the gross postal revenues, $37,935, and the expenditures, $32,140. Mails were conveyed but three times a week between New York and Boston in summer, and twice in winter. The usual time consumed in forwarding them was five days. Only five mails per week were exchanged between New York and Philadelphia, and the time required to forward them in either direction was usually two days.

LAND ROUTES BETWEEN NEW ENGLAND AND CANADA.

In Edward Everett's address, at the Boston Railroad Jubilee of 1851, he said: "When Dr. Franklin, in 1754, projected a plan of union for these colonies, with Philadelphia as the metropolis, he gave as a reason for this part of the plan, that Philadelphia was situated almost half way between the extremes, and could be conveniently reached even from Portsmouth, New Hampshire, *in eighteen days*. . . . If a journey had been contemplated in the direction of Canada in Dr. Franklin's time, it would have been with such feelings as a man would have now-a-days, who was going to start for the mouth of Copper Mine river and the shores of the Arctic sea. But no, sir; such a thing was never thought of—never dreamt of. A horrible wilderness, rivers and lakes unspanned by human art, pathless swamps, dismal forests that it made the flesh creep to enter, threaded by nothing more practicable than the Indian's trail, echoing with no sound more inviting than the yell of the wolf



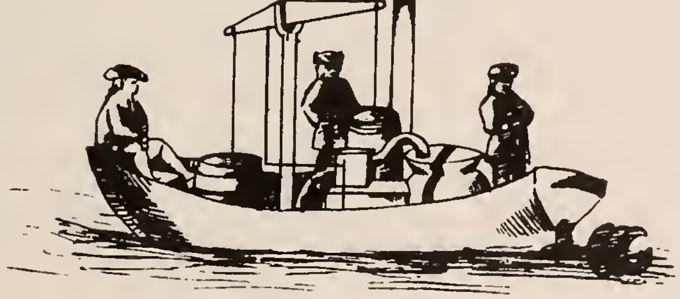
John Fitch's Second Experimental Boat, 1787.



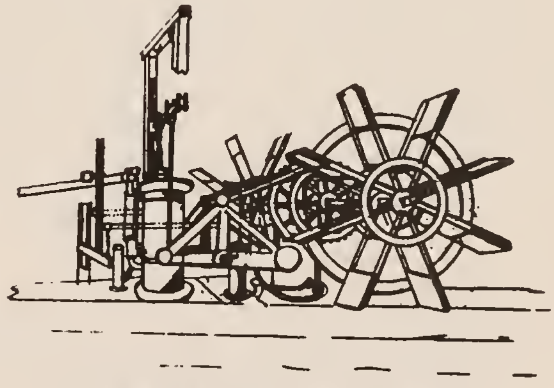
Oliver Evans' Orukter Amphibolis.

Fitch's First Passenger Steamboat, 1789.

Fulton's First Successful Steamboat.



John Fitch's First Propeller.



Machinery of Fulton's Steamboat.

and the war-whoop of the savage; these it was that filled the space between New England settlements and Canada. The inhabitants of the British colonies never entered Canada in those days but as provincial troops or Indian captives; and lucky he that got back with his scalp on."

THE BLAZED TRACE.

It is related of Daniel Boone, that in the spring of 1775, after the close of the Indian war, he assisted in conducting a treaty by which the savages agreed to relinquish lands south of the Kentucky river. When this task was accomplished Boone prepared for introducing a colony into the new territory thus theoretically relieved from savage control by making a "blazed trace" which is one of the most primitive forms of road making. After the treaty was concluded "he was the first man to advance beyond the Cumberland Gap, and, with twenty hunters and woodsmen, he proceeded to open and mark a trace more than two hundred miles through the wilderness to the banks of the Kentucky river. This was the first blazed trace in Kentucky."

SIGNIFICANCE OF "PORTAGE."

Of the emigration movement of colonists of Connecticut to the Wyoming valley in Pennsylvania, in 1719, it is stated that they followed an Indian path, but that having carts and oxen they used their axes and made the first wagon road from the Delaware river to the north branch of the Susquehanna river.

In constructing a road over such a route they followed a general custom, as many of the Indian trails led from one river to another, forming portages or connecting links between the favorite water channels over which nearly all extensive movements were conducted, and a large proportion of all the early roads served similar ends, being in fact "portages."

George Catlin gives the following description of a typical portage movement made by the Chippeways around the Falls of St. Anthony, after a considerable body of the tribe had concluded a treaty with the Sioux: "The Chippeways struck their tents by taking them down and rolling up their bark coverings, which, with their bark canoes turned up amongst their wigwams, were carried to the water's edge; and all things being packed in, men, women, dogs, and all, were swiftly propelled by paddles to the Falls of St. Anthony, where we had to witness the mode of passing the cataract, by *making* (as it is called) *the portage*, which we found to be a very curious scene; and was done by running all their canoes into an eddy below the Fall, and as near as they could get by paddling; when all were landed and everything taken out of the canoes and with them carried by the women, around the Fall, and half a mile or so above, where the canoes were put into the water again; and goods and chattels being loaded in, and all hands seated, the paddles were again put to work, and the light and bounding crafts began their voyage."

In this case the land movement was only made around the falls of a single river, but thousands of trails were established between favorite points for launching or withdrawing canoes from streams or rivers located at varying distances from each other, and it was on the lines of such trails that a large number of the existing roads were constructed.

ROADS OF 1800.

The celebrated poet Thomas Moore gives a vivid description of the bad qualities of the American roads he journeyed over during his visit to the United States, soon after 1800. One of his poems, written during a trip in Virginia, commences thus:—

Dear George! though every bone is aching,
After the shaking
I've had this week, over ruts and ridges,[3]
And bridges,[4]
Made of a few uneasy planks,
In open ranks
Over rivers of mud, whose names alone
Would make the knees of stoutest man knock.

Two notes, added to illustrate this text, are as follows:—

[3] What Mr. Weld says of the national necessity of balancing or trimming the stage, in passing over some of the wretched roads in America is by no means exaggerated. "The driver frequently had to call to the passengers in the stage to lean out of the carriage, first on one side, then on the other, to prevent it from oversetting in the deep ruts with which the road abounds. 'Now, gentlemen, to the right!' upon which the passengers all stretched their bodies half way out of the carriage to balance on that side. 'Now, gentlemen, to the left!' and so on."—*Weld's Travels.*

[4] Before the stage can pass one of these bridges the driver is obliged to stop and arrange the loose planks, of which it is composed, in the manner that best suits his ideas of safety, and as the planks are again disturbed by the passing of the coach, the next travelers who arrive have, of course, a new arrangement to make. Mahomet, as Sale tells us, was at some pains to imagine a precarious kind of bridge for the entrance of Paradise, in order to enhance the pleasures of arrival. A Virginia bridge, I think, would have answered his purpose completely.

The American Annual Register for 1796, published January 19th, 1797, gives the following description of the traveling of that period: "The roads from Philadelphia to Baltimore exhibit, for the greater part of the way, an aspect of savage desolation. Chasms to the depth of six, eight, or ten feet occur at numerous intervals. A stage coach which left Philadelphia on the 5th of February, 1796, took five days to go to Baltimore. The weather for the first four days was good. The roads are in a fearful condition. Coaches are overturned, passengers killed, and horses destroyed by the overwork put upon them. In winter sometimes no stage sets out for two weeks."

It is stated that when President John Adams and his wife, Abigail, drove overland to the new capital at Washington, in November of 1800, they lost their way in the Maryland woods between Baltimore and the Potomac.

PRIMITIVE METHODS OF CROSSING RIVERS.

Captain Basil Hall gives a graphic description of a primitive method of conveying horses and carriages over a river too deep to be forded at a point where a bridge had been carried away and no regular ferry established. The work was superintended by a boy paddling in a canoe not twice his own length. He first carried over the passengers entrusted to his care, one at a time. "The next job was to ferry the baggage over; and this effected, the horse was towed across by the nose; an operation of some delicacy both to actors and spectators. Lastly, came the transportation of the wagon, and here all my seamanship served only to show the hazard incurred of losing the whole conveyance. If the rope, which was what we call at sea inch and a half line, or rotten stuff, but old and much worn, had given way, as I fully expected it would, when the wagon was half channel over, and nothing in sight but four or five inches of the railing above the water, we must have bivouac'd where we were, on the left bank of the Rouge. Fortunately we succeeded in dragging the carriage across, and when the fore wheels fairly touched the bank, I thought, of course, that all our difficulties were over. But the united strength of all the party, males and females, young and old combined, could not budge it more than a foot out of the water. I don't know what we should have done had we not spied, near the landing place, a fathom or two of chain, one end of which our active little commanding officer soon tied to the carriage, and the horse being hitched to the other, we drew it triumphantly to land, with a cheer which made the forest ring again."

PRESENT LACK OF GOOD ROADS.

An English traveler, who visited this country in 1882, in recounting his impressions, says: "The lack of good roads is a general feature wherever I have been. I do not say that I saw no good roads in America, but they are certainly exceptional. In many parts, as I before remarked, the railroad has come before the road. Even in the immediate neighborhood of large towns, sometimes even in the streets of large towns themselves, the road is simply a mass of mud. I do not mean merely such mud as in many parts of England we are used to after rain; I mean thick, abiding mire—abiding, at least, for several months together."

COMMON-ROAD IMPROVEMENTS.

To a very limited extent, the work of constructing roads has been undertaken and performed by the United States government. It furnished a few of the best roads east of the Mississippi, and opened or improved a few great highways west of the Missouri. It also rendered a lasting and invaluable service in all the new states and territories by incorporating in its land system features which greatly facilitate the opening of roads. By making the outside boundaries of each section of land available for a continuous road, highways many miles in length can be opened without raising intricate questions relating to damages, and the propriety of exercising the right of eminent domain; and when deflections from a straight line are necessitated by swamps or other obstructions there is usually little difficulty in procuring the consent of parties to the appropriate modifications of routes. There is such a strong natural proclivity among many farmers to an avoidance of roads through their farms that it was formerly common in some of the older states to construct roads between important points around farms, rather than through them, even when the shape of the environed estates was irregular, and thus travelers and transporters were often subjected to a serious loss of time and inconvenience, occasioned by a motive which has been eliminated, to a great extent, from the regions which originally formed part of the public domain of the United States.

In some of the states in which road-making received the most liberal governmental aid it was rendered from three sources, viz., the commonwealth, the counties, and the townships, and three classes of roads, known as state, county, and township roads, were created. This road system and many ot these roads have been growing worse instead of better, partly because substitutes have been provided. Making due allowance for the superior and unusual excellence of the roads of a comparatively few localities, especially those embraced in or adjajacent to cities, and for the relatively good condition of roads constructed on routes favored by the natural characteristics of the soil and climate, such as gravel roads or roads over the plains, it is scarcely an exaggeration to say that, notwithstanding all that has been done by a few classes of governmental authorities, nearly all the excellent roads of the country have been built by companies as corporate enterprises.

CORDUROY ROADS.

In a sketch of the Civil Engineering of America, by David Stevenson, printed in London in 1838, the following description of the roads in 1837 from Pittsburgh to Erie occurs:—

"On the road leading from Pittsburgh on the Ohio to the town of Erie on the lake of that name, I saw all the varieties of forest-road making in great perfection. Sometimes our road lay for miles through extensive marshes, which we crossed by corduroy roads, formed of trees cut in lengths of about ten or twelve feet, and laid close to each other across the road to prevent the vehicles from sinking; at others the coach stuck fast in the mud, from which it could be extricated only by the combined efforts of the coachman and passengers, and at one place we traveled for upwards of a quarter of a mile through a forest flooded with water, which stood to the height of several feet on many of the trees, and occasionally covered the naves of the coach wheels. The distance of the route from Pittsburgh to Erie is 128 miles, which was accomplished in 46 hours, being at the very slow rate of 2¾ miles an hour, although the conveyance by which I traveled carried the mail and stopped only for breakfast, dinner, and tea, but there was considerable delay caused by the coach being once upset and several times mired."

Captain Basil Hall, in describing one of the primitive highways of Canada, which is unfortunately only a duplicate of many still existing in the United States, says: "The horrible corduroy roads again made their appearance in a more formidable shape, by the addition of deep, inky holes, which almost swallowed up the fore wheels of the wagon and bathed its hinder axle-tree. The jogging and plunging to which we were now exposed, and the occasional bang when the vehicle reached the bottom of one of these abysses, were so new and remarkable that we tried to make a good joke of them. . . . I shall not compare this evening's drive to trotting up or down a pair of stairs, for, in that case, there would be some kind of regularity in the development of the bumps, but with us there was no wavering, no pause, and when we least expected a jolt, down we went, smack! dash! crash! forging, like a ship in a head-sea, right into a hole half a yard deep. At other times, when an ominous break in the road seemed to indicate the coming mischief, and we clung, grinning like grim death, to the railing at the sides of the wagon, expecting a concussion which in the next instant was to dislocate half the joints in our bodies, down we sank into a bed of mud, as softly as if the bottom and sides had been padded for our express accommodation."

Bad as corduroy roads are they represent an important style of improvement, as they embodied in a number of sections the first serious effort to render roads passable by stage coaches. When they were first introduced on leading routes it became necessary to fill up chuck holes, and in marshy places roads were supported by corduroy, consisting of logs or saplings laid close together and across the road. The great end gained by this expedient was the avoidance of the pre-existing necessity imposed on travelers of getting out of the coach and helping to pry it out of the mud. In lieu of this annoyance travelers were subjected to the dangers and discomfort inseparable from an exceedingly rough road,—so rough that they were rattled about like peas in a gourd, and the coach was occasionally upset.

THE SYSTEMS OF REPAIRING ROADS

are in many sections even more imperfect than the provisions for opening and constructing them. An article on country roads, published in the Agricultural Report for 1866, in describing the system of repairs then prevailing in Massachusetts and many other sections of the United States, says: "No one who has once witnessed the process of 'mending the roads' in a small New England country town needs any argument to convince him that a system more ingeniously devised to accomplish nothing was never invented. The surveyors, in the first place, are usually elected at the town meetings, and, as the office of surveyor is of no pecuniary profit beyond mere day wages, persons of peculiar skill, could such be found, would not usually accept it. In fact, the farmers of the district take their turns in the office, any respectable man being deemed fully competent. Often some citizen who lives on a road out of repair seeks the office, and is elected, and takes the opportunity to expend most of the tax on his own road, leaving the rest of the district to be attended to in future. The surveyor selects, not the season when repairs are most needed, but that which is most convenient to himself and his brother farmers, after their spring work is done, or after harvesting, and notifies every person assessed to come and work out his tax. As the citizens, in town meeting, fix the prices to be allowed for the labor of men and animals in thus working out the taxes, it is usually fixed at the highest prices the best men and teams could command, and often much higher, every voter who intends to 'work out his tax' having a direct interest to fix a high price, and they constitute a large majority in town meeting.

"The time appointed for 'working out the highway tax,' as it is rightly termed, arrives, and at 8 A. M. a motley assemblage gathers, of decrepit old men, each with a garden hoe on his shoulder; of pale, thin mechanics, from their shoe shops, armed with worn-out shovels; half-grown boys, sent by their mothers, who, perhaps, are widows, with, perhaps, the doctor, the lawyer, and even the minister, all of whom understand that working on the road does not mean hard labor, even for soft hands. The farmers bring their steers, great and small, with the old mare in the lead, with a cart, and a new citizen drives up, with his rickety horse-cart and the mortal remains of a railroad horse, to do his part. The only effective force on the ground consists of two or three yokes of oxen and a half dozen men hired by the surveyor with money paid by non-residents, or men whose time is of too much value to themselves to be wasted on the road. Here is the surveyor, who never held the office before, and who knows nothing of road-making or of directing a gang of hands. The work must go on in some way. The roads are soft and full of ruts, or rough with protruding stones. The stones must be covered, and the road rounded up into shape. The cattle are all put to the big town plough, which is set in at the side of the road. The boys ride on the beam, and the drivers put on the lash, and the gutters, half filled with the sand and soil and leaves of a dozen seasons, are ploughed up, the shovel and hoe men waiting very patiently for their turn to work. The teams then stand idle, and this mixture, more fit for the compost heap than anything else, is thrown upon the road, and finally leveled and smoothed by the old men with their hoes, and thus the road is mended. This is not an exaggerated picture of working on the road in many small towns. The occasion is regarded rather as a frolic than as serious labor. The old men tell stories to an audience always ready to lean on their tools and listen. The youngsters amuse themselves by all sorts of practical jokes, among which is the favorite one of overloading the carts, when carts are used, so as to stall the teams."

CAUSES OF PROCRASTINATION.

It is difficult, at the present day, to form a conception of the tardiness with which approximately good and passable roads were made during the colonial era, and at much later periods. Among the other causes for procrastination were the wars in which the colonists were involved with the Indians and the French; the drain on the resources produced by the Revolution and conflicts which preceded it; and the expense of Indian wars and the second war with Great Britain. Such disturbing events greatly retarded projects for the construction of bridges, canals, and turnpikes, which were proposed by progressive men in some of the states during the third quarter of the eighteenth century.

ECONOMIC EFFECTS OF ROAD IMPROVEMENTS.

THE inferiority of the colonial and many of the present common roads, as compared with modern standards, is reflected in the length of time required to perform ordinary journeys or to conduct freight movements, and the limited amount of internal trade. The difference between the cost of pack-horse transportation, and the cost of movements in wheeled vehicles over reasonably good roads is so great, that although the Conestoga wagon is now looked upon as a venerable type of antiquity, tardiness, and onerous expense, it was an improvement on pre-existing appliances of scarcely less importance than that represented by the early railways. The strong pack-horses of Scotland usually carried three hundred pounds. With a cart, on inferior roads, one horse could haul five or six hundred weight. By material improvements in roads, it became practical to increase the load of a cart-horse to eight or ten hundred weight. By making first-rate roads the ordinary load of a cart-horse became sixteen hundred weight, and on some good roads a strong horse was able to carry more than a ton. This seven-fold increase in the power of the horse represents a corresponding increase in the areas over which bulky freight could be economically moved, in the incentives to production, and the development of national and individual wealth. The general law governing this subject is well stated by an English writer, who says: "Around every market-place you may suppose a number of concentric circles to be drawn, within each of which certain articles become marketable, which were not so before, and thus become the source of wealth and prosperity to many individuals. Diminish the expense of carriage but one farthing, and you widen the circles, you form as it were a new creation, not only of stones and earth, and trees and plants, but of men also, and what is more, of industry and happiness."

COST OF TRANSPORTATION ON INFERIOR ROADS IN TIME, WEAR AND TEAR, AND MONEY.

The cost of transportation on inferior roads necessarily varies, to a great extent, with the degree and nature of their imperfections, the character of the vehicles used, and the prevailing climatic influences. Over many routes specially unfavorable seasons create a practical blockade, which may be of considerable duration. Snow storms, floods, freshets, heavy rains, freezing and thawing may all greatly impede and sometimes absolutely prevent movements which can be made during favorable epochs with comparative ease and cheapness. The freight charges for transportation over poor roads fluctuates from a prohibitory standard, or a state of things in which goods cannot be moved at any price, through many intervening grades, but the lowest rates attainable are too high to render it possible to move cheap and bulky articles over considerable distances without incurring an expenditure greater than their usual market value in important competitive markets. A gentleman informed the writer that in the spring of 1821 he paid $8 per hundred pounds for carrying barrels of mackerel from Philadelphia to Somerset, and that at that time the rate from Philadelphia to Pittsburgh was $11 per one hundred pounds. The latter rate is equivalent to $220 per ton for a distance of a little more than three hundred miles, or nearly seventy cents per ton per mile. The rate during favorable seasons was much lower, and the high figures given illustrate the extra cost necessitated by the danger of delays and interuptions. One of the perils to be encountered was a snow storm on the Allegheny mountains, which would temporarily render the roads impassable. In towns and cities located in Rocky mountain districts, dependent for supplies upon distant regions, prices for indispensable articles sometimes ran up nearly to famine rates before railways were constructed, because communications with the outside world were cut off at unexpectedly early periods in the fall, or the reopening of trade channels postponed later than usual in the spring.

For some purposes, such as the furnishing of supplies for forts in remote interior districts, wagon transportation over long routes were indispensable, regardless of cost, and figures relating to these movements furnish some of the most reliable data attainable in regard to the prices that have been paid in this country for such service. As the possibility of Indian attacks was intermingled with other risks and dangers, the sums paid were sometimes probably enhanced by this additional peril. The miscellaneous statements appended will enable the intelligent reader to make due allowance for this peculiar circumstance, and to form an approximately correct estimate of the cost of transporting freight over inferior roads, and the extent to which improvements in roads reduce the cost of freight movements.

COST OF MOVEMENTS IN NORTHERN AND NORTH-WESTERN STATES.

The introduction to Poor's Manual for 1881 says that about the beginning.of this century freight designed for Lake Erie and the west was transported over a route leading from Lake Ontario, and that from the mouth of Niagara river to the head of the Falls, was a portage of 28 miles. The charge for transporting a bushel of salt for this distance, according to the report made by Mr. Geddes, in 1809, was 75 cents; and for a ton of general merchandise, $10. This was at the rate of 35$\frac{5}{7}$ cents per ton per mile.

It is stated that previous to 1824 the cost of transporting a ton of merchandise between Buffalo and New York, over earth roads, was $100, and the time consumed was twenty days.

Eagle's History of Pennsylvania, in describing the condition of the settlements west of the Alleghenies cites Dr. Carnahan as authority for this statement: "For several years after the peace of 1783, there was nothing but a horse-path over the mountains; so that salt, iron, powder, lead, and other necessary articles had to be carried on pack-horses from Philadelphia to Pittsburgh. As late as 1794, the year of the insurrection, so bad were the roads *that freight in wagons cost from five to ten dollars per hundred pounds;* salt sold for five dollars a bushel; iron and steel from fifteen to twenty cents per pound in Pittsburgh."

Progress of Nations says of United States in 1852 that "the average price for transporting by teams in this country a bushel of wheat or corn, or 50 pounds of merchandise, 50 miles, has been about 20 cents, and 40 cents for 100 miles, equal to about 15 cents per ton per mile for grain, or $15 per 100 miles, and 18 cents per mile, or $18 per 100 miles, for the transporting of a ton of merchandise."

In a memorial addressed by presidents of Chicago and North-western and Chicago, Milwaukee and St. Paul, to Wisconsin legislature, in 1875, they say: "When the states of Maryland, Virginia, Pennsylvania, and New York entered upon the construction of their canals, a ton of freight could not be carried over an ordinary highway for less than ten cents a mile, even when the highway was in the best condition; while over the country roads, new, as many in this state (Wisconsin) are, with rocky hills and soft, deep soil in the bottom lands, the cost averaged 20 cents per ton a mile."

COST OF WAGON MOVEMENTS IN SOUTHERN AND SOUTH-WESTERN STATES.

In Henry C. Carey's Harmony of Interests, he says, in reference to the transportation of cotton in Mississippi before a railway was constructed, that he obtained from Skinner's Journal of Agriculture the following statement from one who furnished it as the result of his personal observation: "Of the expense of this first movement, some idea may be formed by those who have seen cotton coming over dreadful roads, up to the hub, dragged slowly along 20, 30, or 40 miles, as we have seen it coming into Natchez and Vicksburg, hauled by five yoke of oxen carrying 2,800 to 3,000 pounds, and so slowly that motion was scarcely perceptible. So many perish in the yoke in winter and spring that it has been said, with some exaggeration, that you might walk on dead oxen from Jackson to Vicksburg. *This was before the railroad was made.* A wagon was loaded up, say 14 miles from Natchez, and started at night, and reaches there in time to get back the next night time enough to 'load up.' Thus ten oxen have been wearing and tearing on the road for 24 hours to make one load." Mr. Carey adds: "Here we have five yoke of oxen transporting 3,000 pounds a day, a distance of only 14 miles," and in an estimate of the outlay required for the movement he fixes the average cost of wagons at $80 and of oxen at $40.

Olmstead's Texas Journey, describing a trip through the approaches to eastern Texas, about 1856, says: "We met, in the course of the day, numerous cotton wagons, two or three sometimes together, drawn by three or four pairs of mules or oxen, going slowly on toward Natchitoches or Grand Ecore, each managed by its negro driver. The load is commonly five bales, of 400 pounds each, and the cotton comes in this tedious way, over execrable roads, distances of 100 and even 150 miles. It is usually hauled from the eastern tier of Texas counties to the Sabine, but this year there had been no rise of water in the rivers, and from all this region it must be carried to Red river. The distance from the Sabine is here about fifty miles, and the cost of this transportation is about one cent a pound; the freight from Grand Ecore to New Orleans, from one to one and a quarter cents."

COST OF WAGON MOVEMENTS ON THE PLAINS.

In a report of a committee of the House of Representatives of the United States, dated May 25th, 1868, in regard to the Kansas Pacific Railroad, they say that "there are three regiments of troops in New Mexico (two of infantry and one of cavalry), nearly all the supplies for which are wagoned from the end of the Kansas Pacific Railway at a cost of $1.28 per 100 pounds per 100 miles This is at the rate of $25.60 per ton of 2,000 pounds per 100 miles, or $25\frac{6}{10}$ cents per ton per mile." The authority for this statement is a letter written by D. H. Rucker, Acting Quartermaster-General, to W. J. Palmer, treasurer of the Kansas Pacific, dated June 6th, 1868, which shows that the rate named above was considerably below the average rates, as will be seen by the following extracts, referring to route No. 2 on the road towards New Mexico, over which the railway was then being built:—

"The rates paid by Government for wagon transportation on said route in 1867 were as follows:—

From April to July 8th, $1.28 per 100 pounds per 100 miles.

From July 8th to July 31st, $1.56½ per 100 pounds per 100 miles.

From August to December, inclusive (5 months), $2.16½ per 100 pounds per 100 miles.

The average being $1.79 per 100 pounds per 100 miles, or $35\frac{8}{10}$ cents per ton per mile.

"The rates at which Government has made its contracts for wagon transportation to New Mexico for 1868–9 are:—

From April to November, $1.29 per 100 pounds per 100 miles.

For November, $1 75 per 100 pounds per 100 miles.

From December, 1868, to April, 1869, $2 per 100 pounds per 100 miles.

The average being $1.42 per 100 pounds per 100 miles, or $28\frac{4}{10}$ cents per ton per mile."

This letter also stated that "the lowest rates paid by the United States for wagon transportation, under its contracts, since 1864, inclusive, being the summer or lowest rates, are as follows: 1865, $2.05; 1866, $1.38; 1867, $1.28; 1868, $1.29."

In 1865 operations of ox trains sent west from Atchison and other Missouri river points to Denver and various plains and mountain places and forts were as follows: A regular freight train, fully equipped, consisted of twenty-six wagons, capable of hauling 6,000 pounds of freight each (which was the ordinary load), and each team was drawn by six yoke of oxen, making 312 oxen to each full train. There were trains double this size, many much smaller, and numerous emigrant parties. At times, during 1865, it was estimated that there were more than thirteen thousand wagons on the road. In the spring of that year freights were about twelve cents a pound from Atchison to Denver, and fifteen cents to the mountains beyond. In the fall of 1865 freights were about 10 cents per pound to Denver and 12½ cents to the mountains. This is at the rate of about 38 cents per ton per mile, but some allowance should be made for depreciation in the currency, legal tenders then being considerably below par.

Rates by ox teams in summer to Denver in 1860 were from 10 to 12½ cents per pound; in 1861, from 8 to 10 cents per pound; in 1864, from 6 to 7 cents per pound; and the general price was 1 cent per pound per hundred miles till the railroad was built. At this same time in winter Denver merchants paid 25 cents for freight by mule teams. Time from Omaha to Denver, 40 to 60 days by cattle trains. To Salt Lake in 1860 the rate was 25 to 30 cents, and the time about six months.

Hall's Guide to the Great West, published in 1865, says: The following items in regard to the condition of the roads leading from the Missouri river to Fort Kearney are published in the Omaha City Republican of July 21st. They are worthy of an attentive perusal:—

"The roads north and south of the Platte are equally safe or dangerous. Military posts are established on the south roads from Big Sandy to Kearney, and the northern road is protected by military stations from Columbus to Kearney, besides advanced cavalry posts at Pawnee Reserve, Wood river, and Loup Fork, over which stream a good ferry is running. The Platte can be forded opposite Kearney.

"Trains going west from Kearney are required to form in companies of fifty armed men, and must select one of their number to act as captain, under whose control the train remains until it reaches its destination. It is advisable to form companies in the towns on the Missouri, as this precaution gives greater security to the trains, and avoids unnecessary delay and expense at Kearney City.

"Small bands of Indians are hovering along the roads, awaiting a chance to plunder single wagons or small trains, as they have recently done on the South Platte road. The Pawnee Indians, whose reserve is on the north side of the Platte, are supposed to have committed these depredations; therefore, the military commanders at Big Sandy and Columbus have instructions to halt all trains at these stations until they number twenty armed men. At Fort Kearney, when the fifty armed men have selected their leader, his appointment will be approved by the post commander. At Brownsville, Nebraska City, Plattsmouth, and Omaha subaltern officers are stationed, who will give all information regarding western travel that may be needed by the emigrant or freighter. These, at present, are the military regulations, and we give them for the benefit of those directly interested."

Of the journey to Colorado from Missouri river towns in 1865

Hall's Guide to the Great West said: "Emigrants with good ox teams will make the distance in from 30 to 40 days. Parties of 25, 50, or 100 emigrants, by clubbing together, can provide the necessary outfits at reduced rates, and cross the plains at an expense, it is said, not exceeding $25 to $35."

In giving advice as to such journeys, the Guide says: "As to a team, for many reasons the ox is preferable, first, because a team of oxen is cheaper than horses or mules; secondly, because they require less feed and attention, and lastly, because they seldom stray, and are, therefore, not as liable to be stolen or stampeded by the Indians as horses or mules. As to a wagon, I advise you not to purchase an expensive one. A common lumber wagon, such as a farmer would select to do his ordinary farm work, is the most suitable. . . . It should be of the best seasoned lumber, and put together firmly, so as to stand the drought of the plains, and should be covered with canvas, and lined overhead with oil-cloth, so that there will be full protection in stormy weather."

MOVEMENTS IN THE ROCKY MOUNTAINS.

Captain Marcy's Prairie Traveler, describing overland routes to California and Oregon before continental railways were constructed, says:—

"Wagons with six mules should never, on a long journey over the prairies, be loaded with over 2,000 pounds, unless grain is transported, when an additional 1,000 pounds may be taken, provided it is fed out daily to the team. When grass constitutes the only forage 2,000 pounds is deemed a sufficient load. I regard our Government wagons as unnecessarily heavy for six mules. There is sufficient material in them to sustain a burden of 4,000 pounds, but they are seldom loaded with more than half that weight."

The probable duration of an overland journey in trains from the Missouri river to California, after the routes had been well established, was estimated at about 110 days.

Captain Mullan, of the United States army, in a report relating to one of the national highways he constructed, says:—

"Thus ended my work in the field, costing seven years of close and arduous attention, exploring and opening up a road of 624 miles from the Columbia to the Missouri river, at a cost of $230,000. . . . Our road involved 120 miles of difficult timber cutting, 25 feet broad, and 30 measured miles of excavation, 15 to 20 feet wide. The remainder was either through an open, timbered country, or over open, rolling prairie." He thinks a reasonable time for the journey, would be, "allowing eighteen days for delays, contingencies, and recruiting animals, forty-five days, with loaded wagons; or thirty-five days if you are traveling with pack animals."

In the early years of the nineteenth century it took Lewis and Clarke, the celebrated explorers, two years and a half to travel from the Mississippi to the mouth of the Columbia river and return.

COMMENCEMENT OF THE TURNPIKE AND BRIDGE ERA.

THE first advance in American internal transportation systems of considerable significance, beyond the slow and gradual improvement of local roads, was derived from the construction of turnpikes and bridges, by companies, whose capital was in some instances partly derived from state or county subscriptions, and in others wholly from individuals. The general state of affairs at the beginning of the nineteenth century may be summed up in the statement that attempts to construct and operate steamboats had been so unfortunate in their immediate results that they were practically abandoned; some money had been expended on projects for improving the navigation of internal rivers without conferring any lasting and extensive benefit; a few canals had been commenced, but no such works of considerable length or importance had been completed; and experience seemed to indicate that the best if not the only practicable method for effecting important improvements was to enlist private capital by the hope that the revenue derived from tolls would render turnpikes and bridges over important rivers remunerative investments. In 1792 the legislature of Pennsylvania appointed a body of commissioners to make an artificial road from Philadelphia to Lancaster, and this initial step and the formation of a turnpike company led to the construction of the first extensive turnpike in the United States. The distance from the Schuylkill river along this road to Lancaster is sixty-two miles and a quarter.

The capital of the Philadelphia and Lancaster Turnpike Company was $360,000, but this sum being found insufficient, it became necessary to apply a considerable portion of the tolls to the completion of the work, and a precedent was thus established for the custom, which subsequently became common among American railroad companies, of using a portion of net earnings to finish or improve their lines. Another adjunct of the turnpike movement was the grant by the legislature of Pennsylvania, in 1798, to Mr. Abraham Witmer, of the right to erect as his private property the bridge over the Conestoga, near Lancaster, which formed part of the line of the turnpike, and the incorporation, in the same year, of a company authorized to build a bridge over the Schuylkill river at Market street, by which direct and convenient entrance into the city of Philadelphia from the eastern terminus of the turnpike was obtained. It is stated that the expense of this bridge was $300,000, and at the time of its completion, in 1801, it was the most important work of the kind in the United States. Its length was 750 feet, and width 42 feet.

The turnpike improvements continued to expand rapidly during the early part of the present century, until the turnpike system of Pennsylvania extended throughout the entire length of the commonwealth from Philadelphia to Pittsburgh, and west of that city to Ohio, and to penetrate many other portions of the state. In New York, New Jersey, New England, and all other progressive regions corresponding movements were made.

But about the commencement of the century the only turnpike then finished in Pennsylvania was the Philadelphia and Lancaster, and the only other turnpike company then chartered in Pennsylvania was the Lancaster and Susquehanna, which was commenced in 1801 and finished in 1803. It was practically an extension of the Philadelphia and Lancaster Turnpike to the Susquehanna river at Columbia.

ECONOMIC EFFECT OF TURNPIKES.

Although the great utility of turnpikes in reducing the cost of freight movements had at that period been well tested in England, either the lack of capital or want of confidence in the earning value of the stock of turnpike and bridge companies rendered it difficult to procure the means necessary to construct these roads as rapidly as they were desired by many communities.

The relative advantages of canals and turnpikes was discussed. Some of the figures and estimates given in connection with the various schemes suggested throw an interesting light upon the views then prevalent in reference to the vital subject of cost of transportation. One of the great points gained by turnpikes was the establishment of much easier grades than those common on ordinary roads, and the other end promoted was the creation of a relatively hard and smooth surface. The theories bearing on the effect of these improvements have been summarized as follows: It is found that upon a slope of 1 in 44, or 120 feet to the mile, a horse can draw only three-fourths as much as he can upon a level; on a slope of 1 in 24, or 220 feet to the mile, only half as much; and on a slope of 1 in 10, or 528 feet to the mile, only one-fourth as much; but these proportions vary with the condition of the road, the grade being virtually increased by its softness. The greatest estimated inclination down which horses can safely trot is 1 in 60 on roads paved with blocks; 1 in 35 or 40 on macadamized roads; and 1 in 15 on gravel or dirt roads.

TOLLS AUTHORIZED ON TURNPIKES.

The act incorporating the Philadelphia and Lancaster Turnpike Company was approved April 9th, 1792. It was entitled "An act to enable the Governor of this commonwealth to incorporate a company for making an artificial road from the city of Philadelphia to the borough of Lancaster." The preamble is as follows: "Whereas, the great quantity of heavy articles, of the growth and produce of the country, and of foreign goods, which are daily transported between the city of Philadelphia and the western centres of the state, requires an amendment of the highway, which can only be effected by artificial beds of stone and gravel, disposed in such manner as to prevent the wheels of carriages from cutting into the soil, the expenses whereof will be great, and it is reasonable that those who will enjoy the benefits of such highway should pay a compensation therefor, and there is reason to believe that such highway will be undertaken by an association of citizens, if proper encouragement be given by the legislature," &c.

The enacting clauses, which follow, embrace a section relating to tolls, which authorizes the company "to appoint such and so many toll-gatherers as they shall think proper, to collect and receive from all and every person and persons using the said road the tolls and rates hereinafter mentioned, and to stop any person, riding, leading, or driving any horses, cattle, hogs, sheep, sulkey, chair, chaise, phaeton, cart, waggon, wain, sleigh, sled, or other carriage of burthen or pleasure, from passing through the said gates or turnpikes, until they shall respectively have paid the same; that is to say, for every space of ten miles in length of the said road the following sums of money, and so in proportion for any greater or lesser distance, or for any greater or lesser number of sheep, hogs, or cattle, viz.: For every score of sheep, one-eighth of a dollar; for every score of hogs, one-eighth of a dollar; for every score of cattle, one-quarter of a dollar; for every horse and his rider, or led horse, one-sixteenth of a dollar; for every sulkey, chair, or chaise, with one horse and two wheels, one-eighth of a dollar; for every chariot, coach, stage-waggon, phaeton, or chaise, with two horses and four wheels, one-quarter of a dollar; for either of the carriages last mentioned, with four horses, three-eighths of a dollar; for every other carriage of pleasure, under whatever name it may go, the like sums, according to the number of wheels and horses drawing the same; for every cart or waggon, whose wheels do not exceed the breadth of four inches, one-eighth of a dollar for each horse drawing the same; for every cart or waggon, whose wheels shall exceed in breadth four inches, and not exceed seven inches, one-sixteenth of a dollar for every horse drawing the same; for every cart or waggon, the breadth of whose wheels shall be more than seven inches, and not more than ten inches, or, being of the breadth of seven, shall roll more than ten inches, five cents for every horse drawing the same; for every cart or waggon, the breadth of whose wheels shall be more than ten inches, and not exceed twelve inches, or, being ten inches, shall roll more than fifteen inches, three cents for every horse drawing the same; for every cart or waggon, the breadth of whose wheels shall be more than twelve inches, two cents for every horse drawing the same."

In addition to the discrimination in tolls favorable to broad-wheeled wagons, the act of incorporation provided that "no wagon or other carriage with four wheels, the breadth of whose wheels shall not be four inches, shall be drawn along the said road between the first day of December and the first day of May following, in any year or years, with a greater weight thereon than two and one-half tons, or with more than three tons during the rest of the year." Another clause declared that "no greater weight than seven tons shall be drawn along the said road in any carriage whatever, between the said first days of December and May, nor more than eight tons during the rest of the year." These tolls on broad-wheeled wagons were lower than those charged a few years after the turnpike went into operation, and the increase which evidently occurred is accounted for by a clause in the original charter stating that if the tolls authorized do not secure a six per cent. dividend the company is empowered "to increase the tolls herein above allowed so much, on each and every allowance thereof, as will raise the dividends up to six per cent. per annum."

PROGRESS OF TURNPIKE AND BRIDGE CONSTRUCTION IN PENNSYLVANIA.

A very distinct account of the progress made in Pennsylvania up to 1822, in the construction of turnpikes, canals, and bridges, is furnished by a report on this subject made to the Pennsylvania senate on March 23d, 1822, which gives the results of an elaborate investigation. It stated that the length of the turnpike roads for which charters had been granted was 2,521 miles, of which 1,807 had been completed. To the capital of these companies individuals had subscribed $4,158,347, and the commonwealth had subscribed $1,861,542. An estimate of the debts incurred, added to the subscriptions, made the total cost of the turnpikes $6,401,474. For the construction of bridges $1,629,200 of stock had been subscribed by individuals, and $382,000 by the commonwealth, and these sums added to estimated amount of debts made the total sum contributed to the construction of bridges $2,051,795. To navigation companies the report stated that individuals had subscribed $1,416,610, the commonwealth had subscribed $130,000, the cost of the works at the two Conewago canals was estimated at $220,000, the estimated expenditure on the Lehigh by White & Co. was $150,000, so that, exclusive of the expenditures made by the Schuylkill and Susquehanna, and Delaware and Schuylkill Navigation companies, the appropriations to this branch of internal improvement were estimated at $1,916,510, and the entire outlay for turnpikes, bridges, and navigation companies (exclusive of the three companies just named) was estimated at $10,369,779.

In reference to the districts traversed by the turnpikes then completed or in course of construction the report said: Suffice it for the present to say, that when the works now in progress shall be completed there will be two complete stone roads running from Philadelphia to Pittsburgh, 300 miles each in length, one of which is already finished. One continued road from Philadelphia to the town of Erie, on the lake of that name, passing through Sunbury, Bellefonte, Phillipsburg, Franklin, and Meadville. Two roads having but a few miles of turnpike deficient, from Philadelphia, one to the New York state line, in Bradford county, passing through Berwick, and one to the northern part of the state, in Susquehanna county, passing through Bethlehem. One continued road from Pittsburgh to Erie, passing through Butler, Mercer, Meadville, and Waterford. The report claimed that when these lines were all completed "the northern, north-western, and western sections of the state will then be connected with the metropolis, *and afford facilities for traveling and transportation, unequalled as to extent in the United States.*"

These satisfactory announcements were, however, accompanied with the statement that many of the new turnpikes had been constructed in a very imperfect manner, and an intimation that it was doubtful whether the best methods had been adopted in any instance. The report said: "The art of making artificial roads is in its infancy in our country, and it behooves us, as we value our prosperity, to use every means within our reach to profit by the lights and experience of those who understand the subject better than ourselves. The construction of stone and other artificial roads is a science which few men understand, and yet which few men hesitate to undertake, and it is no doubt from a want of ordinary skill in preparing and applying the materials of which our roads are composed, and in shaping their surface, and of ordinary judgment in the application of labor, that most of our roads have been constructed so expensively, and some of them so badly." The report then refers to information the committee had gleaned from a small English publication, entitled "McAdam on Roads," indicating that a superior system of road-making had been successfully adopted through his labors.

Of the turnpike system of Pennsylvania, Mr. George W. Smith, writing in 1828, said: "Since the year 1792, 168 companies have been incorporated for the purpose of making about 3,110 miles of turnpike roads. One hundred and two have gone into operation, and have constructed nearly 2,380 miles of roads, passable at all seasons, at an expense of $8,431,059.50. The turnpike from Lancaster to Philadelphia extends 62 miles; was commenced in 1792, finished 1794. . . . Other turnpike roads have since been connected with it, extending from Trenton, on the Delaware, to Steubenville, on the Ohio, a continuous line of 343 miles, the cost of which, including the bridges, has exceeded the sums expended on the celebrated road of Napoleon over the Simplon. . . . The whole surface of the state is traversed with the numerous turnpikes, which extend their branches to the remotest districts. *None of them have yielded* *dividends sufficient to remunerate their proprietors.* Most of them have yielded little more than has been expended in their repairs, and some have yielded tolls not sufficient even for this purpose, and, consequently, in some cases, have been abandoned by their proprietors; but they must not, therefore, be regarded as having occasioned an unprofitable expenditure of capital. The stockholders in general were the proprietors of the land traversed, and, consequently, benefited by these roads, or they were merchants, interested in reducing the expense and obtaining a certainty of transportation, which objects were effected by these roads. Before their construction *regularity of transportation was impossible.* During the rainy season, or on the breaking up of the frost, wagons were frequently detained on the road, sometimes for weeks. The merchandise contained in them was subject to injury from the roughness and dangerous condition of these highways. The reduction in the expense of transportation, added to the increased value of the lands adjacent to the three great turnpikes, leading from Philadelphia, Pittsburgh, Erie, and Tioga, have amounted to a sum which, at the lowest estimate, exceeds the cost of constructing, not only these roads, but of all the turnpikes in the state collectively." The system of construction, however, is criticised. Mr. Smith says that "McAdam's plan, as it is erroneously called, has been practiced only in two or three cases, but to a very limited extent, and even for this partial introduction of it we are indebted more to circumstances than to design." He adds, however, that sundry faults he describes "are common to the turnpikes of the Union generally," and that "the roads of Pennsylvania are constructed with a greater regard to solidity and duration than those in the other states."

OPPOSITION TO TURNPIKES AND THEIR EFFECT IN IMPROVING FACILITIES FOR TRAVEL.

In Governor Wolf's annual message to the legislature of Pennsylvania, dated December 7th, 1831, he says:—

"The first turnpike road ever constructed in the United States is indebted for its commencement and completion to the state of Pennsylvania, and although avarice and prejudice had well nigh demolished that proud monument, the Philadelphia and Lancaster turnpike road, reared by the spirit of improvement that manifested itself at so early a period, by a fierce and violent opposition to it in all its stages, still perseverance overcame opposition, the highly useful and valuable enterprise was eventually completed, and the distance between Philadelphia and Lancaster, which before its construction required nearly as much time to travel as it now occupies the mail stage to perform the journey between Philadelphia and Pittsburgh, is now traveled in less than a single day. . . . We have now within this happy commonwealth more than 2,500 miles of turnpike roads, and notwithstanding the uniform opposition that has always manifested itself against every attempt to enter upon a new project of improvement, Pennsylvania has now within her limits internal improvements, consisting of turnpike roads, canals, railways, and bridges, all of them constructed since 1791, for which there has been disbursed from the public treasury of the state, and by corporations, a sum exceeding $37,000,000."

CHARACTERISTICS OF TURNPIKE DEVELOPMENT.

TURNPIKES OF NEW YORK.

ONE of the most important turnpikes of New York was called the Mohawk and Hudson. It was opened early in the present century. A writer who says he passed over it frequently during the war of 1812 says that "it was run in a direct line from the city of Albany to the city of Schenectady; was about sixty feet in width. The hills were graded down to an easy ascent both ways, and the road paved with common paving stone in places where it was liable to be cut up by the ponderous wheels of the huge wagons used in carrying the war munitions from the former city to the latter, where they were transferred to batteaux and pole boats on the Mohawk river, thence to Lake Ontario and Lake Erie, and probably to interior stations when needed. The turnpike was ornamented with a row of poplar trees planted on either side, which gave it quite a picturesque appearance for many years, but which proved to be very injurious by shading it and rendering it muddy and almost impassable at times. The vast amount of war material forwarded from the city of Albany destined to the western lakes, passed over this road for some three years, both summer and winter, in large wagons with tires six inches in width and drawn by six and eight horses to a wagon. During the winter months I have seen this road become so smooth from the constant rolling of these wide-tired wheels, that it was very difficult for the horses to keep on their feet. I have seen many of them with their front teeth knocked out, by falling on their noses, and otherwise seriously maimed. From the close of the war of 1812, up to the construction of the Erie Canal, it was the great market avenue for the farmers of the Mohawk valley, and was studded with hotels, or taverns as they were then called, from one city to the other so closely that you could never get out of sight of a swinging tavern signboard."

THE NATIONAL ROAD.

The most important and best-constructed early turnpike in the United States was the National road, leading from Cumberland to Wheeling, and subsequently extended. The length of the line first opened was 130 miles, and the cost of construction $1,700,000. The contracts stipulated that the road should be 60 feet in width, the road-bed 32 feet wide, 20 feet of the graduated part to be covered with stone 18 inches deep at the centre, and tapering to 12 inches deep at the edges, the upper 6 inches of the stone to be broken so as to pass through a ring 3 inches in diameter, and the lower stratum to be broken so as to pass through a 7-inch ring. The stone part was to be covered with gravel, and rolled with an iron-faced roller, 4 feet in length, and made to bear 3 tons. The bridges along the road were superior edifices for the era in which they were constructed.

Although the proposition to construct this road was first made in Congress in 1797, and the act providing for its construction was passed in 1806, the first stage-coach bearing the United States mails passed over it from Cumberland to Wheeling on August 1st, 1818. Of the construction of one of its sections, 11 miles long, reaching from Braddock Grove to Uniontown, which was reached in 1817, A. L. Little, Esq., formerly of Fayette county, Pennsylvania, wrote: "I was there to see it located, and the stakes stuck down the mountain across the old commons south of Woodstock, afterwards Monroe, . . . before a shovelful of earth was displaced, and also to see that great contractor, Mordecai Cochran, with his immortal Irish brigade, a thousand strong, with their carts, wheel-barrows, picks, shovels, and blasting tools, grading those commons, and climbing the mountain-side, . . . and leaving behind them a roadway good enough for an emperor to travel over."

This national road continued to be, for a considerable period, the favorite national highway for connecting the settlements east and west of the Allegheny mountains, and especially for the journeys of congressmen and travelers to and from Washington. Stage movements probably never gained a higher state of perfection in this country than on this route, as mail contractors were anxious to make a good impression on the senators and representatives who traveled in their coaches and whose influence might prove potential in transactions with the post-office department or appropriations for postal service.

Of this road, as of many other turnpikes, it is stated that heavy travel and failure to make proper provision for timely repairs, wore out the bed. Of the turnpikes of the country, generally, a civil engineer in addressing his associates says that "under the effects of frost, rain, and the heavy traffic, turnpikes became expensive and unprofitable; and people, in good weather, would travel over a parallel road to avoid paying toll. Soon they were unpopular and condemned by the community generally, and most unjustly; for, until over-burdened by the quantity and weight of traffic, they served well their purpose; thereby cities and towns were built up, the lands through which they passed were increased in value five-fold, and the general enhancement of taxable property was ten times the original cost of the turnpikes. Now that they are relieved from heavy and ruinous loads, they are, if well made and kept, as useful and profitable as in their early career."

MODERN USE OF TURNPIKES FOR LIGHT TRAVEL.

Striking illustrations of the correctness of the latter portion of this statement are furnished by the fluctuations which have occurred in the value of the stocks of some of the turnpike companies of the country. In some instances, after sinking from an original cost of $100 a share to $8, they have again risen to nearly par.

An officer of a turnpike company in Pennsylvania, whose stock has undergone such transitions, has furnished the writer with the following explanation of its operations during a period of about fifty years. It was chartered on March 20th, 1810. The schedule of rates of toll for every five miles was as follows: For every horse or mule, laden or unladen, with his rider or leader, 3 cents; for every sulky, chair, chaise, with one horse and two wheels, 6 cents; with two horses, 9 cents; for every chair, coach, phaeton, chaise, stage-wagon, coachee, or light wagon, with two horses and four wheels, 12½ cents; for either of the carriages last mentioned, with four horses, 20 cents; for every other carriage of pleasure, under whatever name it may go, the like sums, according to the number of wheels and of horses drawing the same; for every sleigh or sled, for each horse drawing the same, 2 cents; for every cart or wagon, or other carriage of burden, whose wheels do not in breadth exceed 4 inches, for every horse drawing the same, 4 cents; for every cart or wagon, whose wheels shall exceed in breadth 4 inches, and shall not exceed 7 inches, for each horse drawing the same, 3 cents; for every cart or wagon, the breadth of whose wheels shall be more than 7 inches, and not more than 10 inches, or, being of the breadth of 7 inches, and shall roll more than 10 inches, for each horse drawing the same, 2 cents; for every cart or wagon, the breadth of whose wheels shall be more than 10 inches, and not exceed 12 inches, or, being 10 inches, shall roll more than 15 inches, for each horse drawing the same, 1½ cents; for any such carriage, the breadth of whose wheels shall be more than 12 inches, for each horse drawing the same, 1 cent; and when any such carriage aforesaid shall be drawn by oxen or mules in the whole or in part, two oxen shall be estimated equal to one horse, and every ass or mule as equal to one horse in charging the aforesaid tolls.

These rates of toll were never materially changed (up to 1883) in any particular except that the company was obliged to make provision for a charge to be imposed on one-horse four-wheeled vehicles which were either unknown or at least very rarely or never driven over the road when it was first constructed. Gigs, having only two wheels, drawn by one horse, were then the favorite vehicles for private journeys. Subsequently the charge or toll of 10 cents for five miles, or 2 cents per mile was imposed on all pleasure carriages that had four wheels and were drawn by one horse. In reference to the graduation in charges for wagons with varying widths of tire, he states that "the heavy wagons are gradually going out of use, so that we find few wagons of over three inches tread. Our rates now for heavy teams are four cents a horse for five miles,—16 cents for a four-horse team,—while for one horse and a light buggy over the same distance the charge is 10 cents." The road is 15 miles in length. The company was authorized to charge toll as soon as a division of five miles was completed. Three divisions of five miles each were opened successively, in 1816, 1823, and 1825. The primary object was to furnish a roadway for heavy teams, but the revenue derived from them was never sufficient to make the road remunerative. The first dividend was declared in 1839. The company struggled for a number of years to complete its construction, and was assisted by a subscription of the state for one hundred shares ($10,000). This stock was sold about 1843 for $8 per share.

Soon after this period, through increase of population, the extensive introduction of light vehicles, and partly by improvements in management, the income of the company gradually increased above the necessary expenses until, for some years, regular dividends approximating to six per cent. on the par value of the stock were earned and declared. The great cause of the change was the unexpected revenue derived from the light four-wheeled vehicles drawn by one horse, which were not in use at the time the turnpike was constructed. They do not wear the road as much as the heavy narrow-wheeled wagons, and the toll for them is proportionately higher.

ADVANTAGES OF CONVEXITY.

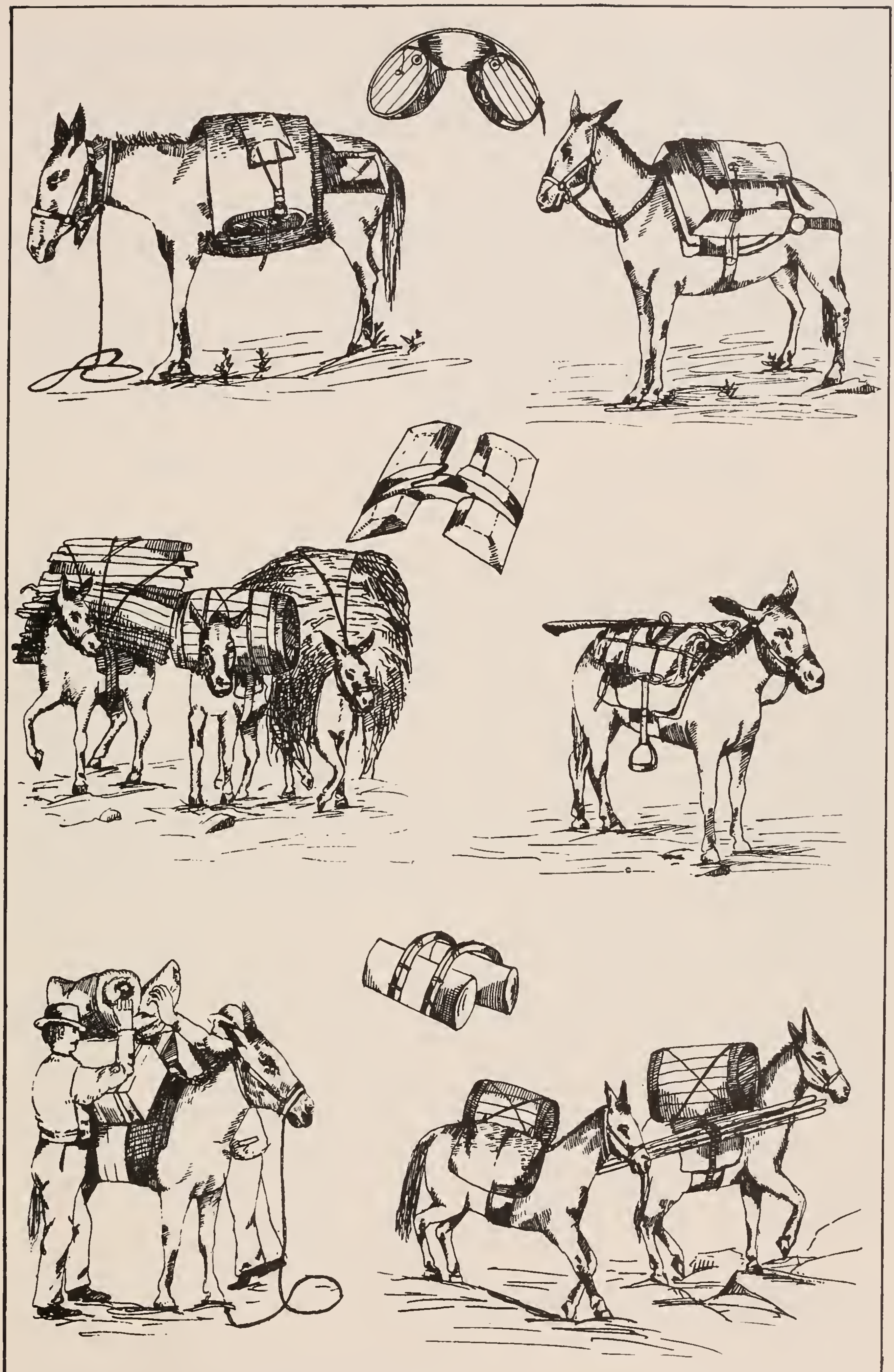
In reference to the construction of this turnpike he says: "Former superintendents of our road seemed to favor flat surfaces, but the practice for some years has inclined to convexity, or a surface highest in the middle and rounding off to the sides. A flat surface has some advantages, in distributing travel over the whole road, and thus making the wear more uniform. In convex roads the travel tends to the higher surface. A flat surface is harder to keep dry, and as travel is most wearing on wet surfaces, our experience seems to demonstrate that convex surfaces are preferable. In repairs we use limestone, believing that it has superior facilities, on account of its tendency to compactness." In reference to the collection of tolls he adds: "We have four gates at an average of three miles apart. It is impracticable to collect toll from all who use the road, and probably one-half of the travel pays no toll, on account of the large number of persons who use the road only at points between the gates, thus avoiding payments."

TURNPIKE FINANCIERING.

In constructing turnpikes, before the era of canals had fully commenced, a variety of methods for securing the requisite financial aid were adopted. Over a few routes the United States government paid the expense. Over many others private companies supplied the means. In some cases they were aided by subscriptions of states to their stock, and in others they received no such assistance. Other turnpikes were constructed or extended by a combination of the contributions of states and counties. The western portion of the turnpike connecting Pittsburgh with Philadelphia was constructed in the manner last described. Of the travel on this road a newspaper writer says:—

THE OLD-TIME TEAMSTERS.

Looking back at the old-time travel along the turnpike, the history of it is most interesting. First of all, both in importance and interest, was the freight traffic on the road. Hundreds and hundreds of men, horses, and wagons, year in and year out, crowded together the busy thoroughfare. Baltimore and Philadelphia were the great centres of traffic for the west, inasmuch as nearly all the buying of goods for western cities was at these places. Merchants made their journeys from Pittsburgh to one or the other of these cities and laid in their spring and autumn supplies. Always coming west were the heavily loaded wagons to be met. Hardly ever were they thus loaded going east. And so it was that all along the turnpike a busy, crowded state of affairs was constantly carried on. The great, high-topped wagons, over which white canvas coverings were fastened, as they passed along the pike in long lines together, formed an interesting sight. Six and eight horses were attached to each wagon to draw the enormous loads upon them. The drivers, walking along at the sides of the horses, now and then touching up one of them, that was shirking his duty, with a formidable "blacksnake" whip, were a curious class of men. They mostly traveled together for company. At night, when the tired teams drew up before the taverns that lined the turnpike throughout its entire length, the teamsters, after attending to their teams, prepared to have a jolly time of it. Whisky was very plenty and cheap, and everybody drank it. Between whisky and cards, the teamsters generally managed to put in a lively night. Occasionally the fun resulted in something worse, and fighting was added to the night's programme. But disturbances were not frequent, and considering the large crowds of these men oftentimes congregated in a tavern at one time, they must be accorded better tempers than those that the whisky of the present day makes. Taverns, as they were then called, were very numerous. Half the houses along the way accommodated the traveler. As many as forty or fifty wagons oftentimes stopped over night at one house.



PACK-MULE AND BURRO MOVEMENTS.

Many of the teamsters carried bed-clothes with them, and spread them out on the floor, where they slept in rows like soldiers. It was a rough life, but they enjoyed it for all that, and when rumors went the rounds that a great railway line was going to be built across the state, and with it would come an end of their life on the turnpike, the howl of opposition from these men would have killed the project, if howls could have done it.

THE OLD STAGE-COACH LINES.

The stage-coach feature of the old turnpike is something with such a dash and liveliness about the very thought of it that it awakens our interest. It was truly the life of the turnpike. Dashing along at a gallop, the four horses attached to the coach formed quite a marked contrast to the slowly-plodding teams drawing the big wagons. Then there was something of more than ordinary interest about the coach itself, and the passengers as well. For many years two great lines of coaches were run between Pittsburgh and Philadelphia. Starting daily, the three hundred and fifty odd miles between the two cities were passed over in about three days—that is, if the roads were in very good condition—but more time was usually required. Every twelve miles a change of horses was made, and quickly. No time was lost, and no rest was given the traveler. It was by no means a ride of great pleasure, but it was the only way, and it was taken without complaining. Usually every six miles a toll-gate was placed, though sometimes the toll-gates were twelve miles apart. There was one cheering thought about the journey that in those days was sufficient to make it bearable, at least to the men. There was plenty to drink along the way, and it was both good and cheap. Ministers, lawyers, statesmen, and all, while horses were being changed at the relay stations, rushed out of the stage-coach to the taverns, and comforted themselves with something cheering. The fare on the stage-coach from city to city varied somewhat, as did the condition the roads were in, or as the rival lines cut the closest on prices. A through-pass ticket from Pittsburgh to Philadelphia was all the way from $14 to $20, which in those days meant more than the same sum does now. There were special rates to emigrants, but they were brought west in large covered wagons, and not on the regular coaches. For twenty-five years emigrant travel formed a big portion of the business along the turnpike. It was mostly from Baltimore, thousands of immigrants landing there, and engaging passage to the west through companies engaged in that business alone.

COST OF TRANSPORTATION ON TURNPIKES.

GAIN IN THE EFFECTIVE FORCE OF HORSES.

THE increase of efficiency of teams, which resulted from the construction of the early turnpikes, is described in the report of the canal commissioners of Pennsylvania in 1831, to be sufficient to enable four horses which would draw on a common road, in addition to the weight of the wagon containing the load, one ton a distance of twelve miles, to move on a turnpike not exceeding five degrees of inclination one and a half tons eighteen miles. Instead of the daily work being equivalent to the movement of one ton twelve miles, it was equal to the movement of one ton twenty-seven miles, a gain of 125 per cent.

Shortly after the Philadelphia and Lancaster Turnpike went into operation a journal of that era, dated January 8th, 1796, publishes an imaginary dialogue, which indicates that considerable effort was at first necessary to convince parties interested that they could advance their individual interests by using the new artificial road, and paying toll. The discussion presumably occurs at a blacksmith shop, and one farmer endeavors to convince the other that he really saved money by paying tolls amounting to six dollars in a five days' trip from Lancaster to Philadelphia, made to carry to market fifteen barrels of flour.

ROBERT FULTON'S STATEMENTS.

As to the actual expense of moving freight over the early turnpikes Robert Fulton made the following statements in a letter addressed to Albert Gallatin, Secretary of the United States Treasury, in 1807: "From Philadelphia to the Susquehanna, at Columbia, is seventy-four miles; that road, if I am rightly informed, cost, on an average, 6,000 dollars a mile, or 444,000 dollars for the whole. On it, from Columbia to Philadelphia, a barrel of flour, say 200 cwt., pays one dollar carriage. A broad-wheel wagon carries thirty barrels, or three tons, and pays for turnpike three dollars; thus, for each ton carried, the turnpike receives only one dollar." This is followed by the statement that the sum usually paid for hauling a ton of flour carried from Columbia to Philadelphia (including the sum paid to the owner of the wagon and team and tolls), was $10, and this calculation: "I will proceed with the Lancaster turnpike, supposing it to extend to Pittsburgh, 320 miles, on which, the carriage being at the rate now paid from Columbia to Philadelphia, that is $10 a ton for 74 miles, the ton from Pittsburgh would amount to $42, at which price, a barrel of flour would cost $4 in carriage, an expense which excludes it from the market."

One important fact demonstrated by these contemporaneous announcements is that the mere cost of tolls on the first long American turnpikes slightly exceeded 1.35 cents per ton per mile, or nearly double the average receipts per ton per mile for all freight movements by the present east and west trunk lines; and the entire cost of moving flour from Columbia to Philadelphia, was at the rate of 13.51 cents per ton per mile, or about eighteen times as large a sum as the average receipts of the trunk lines at the present day.

The old turnpike charges were not specially high, in view of Fulton's statement that "on a road of the best kind four horses, and sometimes five, are necessary to transport only three tons." Among the elements of cost to be included he embraces "the value of the horses, their feeding, shoeing, gear, wagons, and attendance." In his advocacy of canals he estimated the daily cost of the services of a man at one dollar, and a horse at one dollar, and supposing that five horses would be needed to haul three tons of flour from Columbia to Philadelphia, and that the journey of seventy-four miles, and loading and unloading, would be made in three days, the bare cost for the teamster, horses, and tolls would be $21, leaving only a margin of $9 for profit and contingencies; so that if a full return load could not be readily procured the business was not specially remunerative.

MOVEMENT BETWEEN PHILADELPHIA AND PITTSBURGH.

A pamphlet issued by the Empire Transportation Company, in 1876, says: "Before the advent of canals, transportation in Pennsylvania was chiefly performed by wagons, stages, and boats. The wagons, drawn by four or six massive horses, 'with their orchestra of bells,' were huge, broad-tired, canvas-roofed trains, employed by their agricultural owners in the idle farming period between the seed times of autumn and spring. 'Conestoga teams' was their generic title; though 'Pitt teams' designated those plying between the Delaware and the small city of Pittsburgh, at the head of the Ohio. Goods were receipted for, time guaranteed (about eighteen miles per day), and losses paid for by these primitive carriers, much as now. A load ranged from 5,000 to 7,000 pounds; and rates between Philadelphia and Pittsburgh were from two dollars to two and a half dollars per hundred pounds. . . . Merchandise was taken from Philadelphia to Columbia by team, at an expense of 'three levies' (thirty-seven and a half cents) to fifty cents per hundred pounds."

MOVEMENTS ON THE NATIONAL ROAD.

Jonathan Knight, chief engineer of the Baltimore and Ohio, referring to wagon movements on the Cumberland or National turnpike road about 1831, said: "The maximum grade employed in the location and construction of the road was 5 degrees, equal to about 1 in 11½, and there frequently occur stretches of road for miles together ascending mountains at an ascent of 1 in 12. Let us see what is here the actual draft of a horse. The common load for a team of five horses is 4,500 pounds of freight, plus 3,000 pounds for weight of wagon, equal to 7,500 pounds, or 1,500 pounds per horse. The resistance on a level is the one-eighteenth of this, equal to 83 pounds, whilst the gravity on the ascent is the one-twelfth, or 125 pounds. But the resistance in passing up the ascent is the sum of these, that is, 208 pounds. Moreover, the horse has, in addition to this, to overcome the gravity of his own body, which, if he shall weigh 750 pounds, is 62 pounds. This added, shows the force of traction to be really 270 pounds, when all the five horses draw simultaneously and equally, and the road is good. These conditions, however, are frequently not verified, and there is doubtless a necessity in this service to supply horses that shall be capable of exerting a muscular energy of 300 pounds at the least. . . . . The time these horses employ in performing the trip from Baltimore to Wheeling, 266 miles, over this hilly road, is usually 15 days, averaging 18 miles per day." In the same article he estimates "the average daily wages of a driver about 80 cents, and the average cost of a horse, including harness, and every other expense, about 40 cents; of both together, 120 cents." Of the charges for this movement Knight says: "The charge for the carriage of commodities from Baltimore to Wheeling on the turnpike road averages about two cents per pound, or $44.80 per ton on the whole distance of 266 miles, being at the rate of about 17 cents per ton per mile."

Before the construction of the Cumberland road it required eight days to go from Baltimore to Wheeling. This was reduced to three days. In 1828 there was forwarded from Wheeling to Baltimore over the Cumberland road, 1,750 tons of produce by more than 1,000 wagons. The hope was then cherished that by a slight additional reduction in the cost of transportation an annual movement of 100,000 tons of western produce over the road to Baltimore would be secured. Such material gains, however, were reserved for the long list of similar and infinitely greater achievements subsequently made by railroads.

FERRIES AND BRIDGES.

IMPORTANCE AND EXTENT OF ROAD BRIDGES.

ONE of the important adjuncts of turnpike movements was the impetus it gave to the formation of bridge companies, and the adoption of improved methods for crossing small as well as large streams. The general course of progress has been from the dangerous ford to the tardy ferry, from the tardy ferry to a frail or clumsy log bridge, and from poor bridges to graceful and substantial ones. During all the colonial era there was no bridge of considerable magnitude in any portion of the country, while at the present day even the ordinary highway bridges are so numerous and varied in their forms, that they go far to redeem American road-making systems from reproach. Many counties, townships, and road districts that have failed wholly to keep their common roads in proper order have rendered very useful service in constructing bridges, and the large expenditures required for this purpose may help to explain the comparative neglect of the main lines of numerous thoroughfares. In many districts bridges were regarded as the improvements most necessary, inasmuch as roads, after they are once fairly opened, are generally at least passable during the months when the atmospheric conditions are favorable, and it was very desirable that movements should not be arrested by swollen streams.

PRIMITIVE MODES OF CROSSING STREAMS.

When new settlements were founded at many places, one of the first needs keenly felt was an increase of the facilities for crossing streams. Some of the early pioneers were compelled to rely upon the aid of Indians, or to adopt expedients that were very uncomfortable or hazardous. A vivid description of the primitive condition of affairs in relation to this matter, the discomforts it occasioned, and the sort of assistance obtained, is furnished in the following extract from a journal of two religious enthusiasts, Jasper Dankers and Peter Sluyter, who made an overland journey from New York to settlements on the lower Delaware in 1679:—

"We were more anxious in relation to crossing this Millstone (a tributary of the Delaware, running through New Jersey above the falls and below the Raritan), at half-way, where it would be broader and much fuller of water. . . . After we had gone four or five miles, we saw the houses of the Indians on the right, and went to them partly for the purpose of drying ourselves, for though the rain seemed at times to abate, it still continued, and partly to inquire the best way to go, in order to cross the large creek. We entered their dwelling, where we dried ourselves, and breakfasted a mouthful out of our traveling sacks. We presented the Indians some fish-hooks, which pleased them. As to crossing the large creek, they said it was not advisable to wade over, as the water was as high as our shoulders or higher, as one of them showed us, and the current was so swift as to render it impassable. He said that not far from their house lived a *sackemaker*, who had in the creek a canoe, with which he had set a man across the day before, who had a horse which he swam over, but the sackemaker was not pleased at his doing so without his permission. We promised him a guilder to take us to the sackemaker. . . . The Indian having made himself ready, took both our sacks together, and tied them on his back for the purpose of carrying them, which did not suit us badly, as we were very tired. He did that without our asking him, and conducted us in a direction more south-easterly to their king or sackemaker, who lived two or three miles from there. . . . We agreed with the sackemaker to set us across the river for three guilders in zeewan. The sackemaker, being ready, took one of our sacks to carry, and went on ahead of us; and there went this king, carrying our pack, almost without any clothing on his body. He conducted us to the creek, which was two or three miles distant to the north and north-east, over a very difficult and rocky hill. On arriving at the creek, we saw there certainly would have been no way of going over, for the water was very high, and ran like a sluice. We were then put across, I myself helping the *sackemaker* and our sack-carrier in doing it, as it was difficult to go over even in a canoe. He took us a piece of the way, until we came to the right path, and gave us proper directions how to proceed further. He was to come for our guide the next day, and carry him back."

ESTABLISHMENT OF EARLY FERRIES.

The counterpart of the experience just described, with many modifications of a much more disagreeable character, has probably been furnished in millions of instances and in numerous districts. The necessities or requirements indicated naturally led to the establishment of regular ferries or the authorization of charges for conveying horses and persons across streams which could not be conveniently forded. This was a decided improvement on the custom of relying upon Indians for the use of canoes which were not always available and could never carry horses or wagons.

It is noticeable that for some years after legal provision was made for the establishment of ferries in Pennsylvania and New Jersey, the list of charges authorized does not include any mention of wagons or carriages, so that there was probably a prolonged era after travel commenced over some important routes in these provinces before it became common to use vehicles on them. The list of laws made at Philadelphia, in March, 1683, declared that ferry boats for men and horses should be built within one year over the creeks commonly called Neshaminee, Scuilkill, and Christeen, at the charges of the counties they belong into, and that the price of ferriage "shall be two pence a head for carrying over every person, and with a horse, four pence, and for every led horse or other beast three pence." A general revision of laws made in May, 1690, provided for ferriage charges at the places named above, and also over the Delaware river near Burlington, and over the Brandywine, and although the list of charges authorized is extended by specific mention of oxen, bullocks, cows, heifers, horses, mares, sheep, hogs, and horses loaden or unloaden, no reference is made to carriages or wagons. The same omission occurs in a later revision, made in 1693. Of the ferry over the Raritan, at New Brunswick, New Jersey, it is stated that in 1716 when it had been established for twenty years, provision was only made, in the rates allowed by the assembly, for "horse and man" and "single person."

Considerable progress during the next thirty years, however, is shown by the fact that an act passed in Pennsylvania in 1723 for establishing a ferry over the river Schuylkill, at the end of the High street of Philadelphia, in authorizing ferry rates, includes the following: "For a coach or chariot, one shilling, For a chaise of four wheels, six pence. For a chaise of two wheels, four pence. For a cart or wagon, with their loading, one shilling; and without loading, six pence. For a sled, loaded or unloaded, one penny."

ADVANCES IN FERRY SYSTEMS.

Of the ferry systems usually adopted it is stated that at first the ferry boats consisted of canoes lashed together, and the next stage of progress was the construction of plank scows, which were propelled across the streams by oars or pushed by poles.

Another advance was the use of the ferry rope, by the aid of which the scows or flats crossing rivers are kept in or near given points, and their movement facilitated.

In operating ferries established at a few very important crossings of navigable rivers, horse power was employed in propelling boats during the early decades of the present century, but after steamboat construction had become fully successful steam ferry boats at such places came into universal use, and they have continued, with comparatively slight modifications, to serve this purpose in an admirable manner and on a very extensive scale. The leading feature of ferry-boats on the eastern navigable rivers are in accordance with plans devised by Robert Fulton at the outset of successful steamboat navigation, as both ends are alike, and the boats run with equal facility in either direction. These boats are usually comparatively short and broad, and receive horses, vehicles, and passengers from the shore directly on the ends of the main deck, which is widened for the purpose. When being loaded each boat is moved to a bridge with one end carried on a float, and the other pivoted to the shore. Passengers' cabins are located at the sides on the guards, and occasionally an upper cabin is added. These boats are generally made sufficiently strong and powerful to keep up communication through the ice in the coldest winters. The advantages derived from the power to cross rivers without turning are very great, as they include a material saving in time, and increased convenience in loading and unloading. The entire ferry system, of which these double-end boats is an adjunct, was an invention of Fulton's, which affords strong additional proof of his genius and practical talent.

On western rivers the ferry-boats generally run only one way, as they are obliged to struggle against adverse currents, and make broadside landings.

Special ferry-boats of extraordinary size are used between some important points in carrying whole trains of railroad cars, and floats carrying eight to ten freight cars are towed across some of the great tide-water rivers of the country.

EARLY BRIDGE LEGISLATION.

The legal provisions heretofore described in regard to ferries probably typify, with approximate accuracy, the course pursued in many sections of the country, and there were also, presumably, laws passed in a number of the colonies in regard to bridges over small streams similar to the following, adopted in Pennsylvania in 1683: "Be it, &c., That bridges shall be built over all small creeks and rivers (that are difficult, or apt to be high by suddain Rain), in the King's highway, from the falls of Delaware to the southernmost parts of Sussex county, within the space of eighteen months from the time aforesaid, which bridges shall be ten feet broad and a rail on each side; and that all trees, stubbs, and stumps of trees, that lye in, and cross the said highway, and all passages in and out of creeks and branches, may be made safe and easy both for horse and cart, att the chairge of the respective counties in manner aforesaid.

"And the County Court in every County shall every seventh month, yearly chose and appoint, three overseers, at least, for the highways; upon the penalty of ten pounds sterling. And such overseers shall summon in all their inhabitants of the respective limits, to come in and work at the making of all highways and bridges therein, upon the penalty of five pounds; and every inhabitant so summoned as aforesaid, that shall not appear and do his labour, shall pay to the use of the publick twenty shillings sterling."

[A foot note says that this chapter was abrogated by William and Mary, King and Queen, in the year 1693.]

All the words of the above chapter are contained, however, in a codification of "The Law about Building Bridges," which embraces a list of the laws made and passed by Benjamin Fletcher, &c., in 1693, with these changes: There is an addition at the end of matter given above that strengthens it, by making the last sentence read as follows: "Shall pay *per day* twenty shillings for every such neglect to the respective overseers towards repairing the highways and bridges." And after the requirement that the bridges shall be built within the space of eighteen months these words are added: "After the rising of the general assembly."

MILITARY BRIDGES.

The military operations connected with the Revolutionary War gave the first impetus to serious attempts to construct bridges over streams of considerable breadth and depth, and to familiarize the public with such useful works. The necessities of that era were too urgent to afford time for the erection of permanent structures, but the demonstration of the fact that armies could be marched over rivers which had never before been crossed except in floating craft helped to inspire a desire for similar facilities during peaceful epochs. Various devices were employed by both armies. The first bridge over the Schuylkill was built by General Israel Putnam in the winter of 1776–77. It was formed of the floating stages used by ship carpenters. The British built two floating bridges while they occupied Philadelphia. The first was constructed on pontoons or large boats, but it failed to meet all the necessary requirements, and was succeeded by a bridge built of floating logs. At various points throughout the country temporary military bridges were erected, and some of the most important events of the war hinged on the ease with which one army crossed a river at a critical juncture, and the failure of the opposing forces to be equally expeditious in a similar movement, on account of a sudden freshet or other causes.

LARGE PERMANENT BRIDGES.

The general course of bridge improvement throughout the populous and wealthy portions of the country is indicated by the history of the structures over the Schuylkill near Philadelphia, exclusive of railway bridges. The first permanent bridge was constructed by a chartered company, and the undertaking was considered so difficult and gigantic that no American was deemed fully competent to superintend all the complicated operations, and an English engineer crossed the ocean for that purpose. His aid was specially necessary in securing a substantial foundation. The corner-stone of this bridge was laid on October 18th, 1800, and the bridge was thrown open to the public on January 1st, 1805. It was a wooden structure, and cost nearly $300,000. It remained a "toll" bridge until 1840, a period of thirty-five years, and was the only permanent highway bridge over the Schuylkill in or near Philadelphia, until a wooden bridge, with a single span of 340 feet, was constructed by Wernwag, who was one of the most skillful and distinguished of early American bridge-builders, the corner-stone of which was laid on April 28th, 1812. It was destroyed by an incendiary in 1838, and was succeeded by a wire suspension bridge, completed in 1842, which was removed, after being in service for more than thirty years, to make room for an imposing double-decked bridge. The city of Philadelphia has erected four other bridges over the Schuylkill, one of which is an exceptionally large and fine iron bridge, costing $1,404,445. It is one thousand feet long, and one hundred feet wide.

The first public improvement of importance in which Bostonians were engaged, and probably the first important bridge constructed in the United States was a bridge leading from Boston, over the Charles river, which was opened for travel on the 17th of June, 1786.

The Cayuga bridge, of New York, reported the largest in America at the time of its completion, was finished in September, 1800.

CORPORATE BRIDGE BUILDING.

In nearly all instances (but not invariably) the large or important early bridges were built as corporate enterprises, and the disposition to embark in such undertakings was, to a great extent, contemporaneous with the active turnpike movement. In a number of cases the bridges erected under such auspices continue to be toll bridges. In other cases the rights of the companies have been purchased by counties or cities, and the bridges made free. The general style of early legislation in Pennsylvania in reference to toll bridges is indicated by the fact that in one instance, by an act passed in 1792, the builders were authorized to charge the following tolls: "For every coach, landau, chariot, phaeton, or other pleasurable carriage with four wheels, drawn by four horses, the sum of three shillings, and for the same carriages, with two horses, the sum of two shillings and six pence; for every wagon, with four horses, when loaded, the sum of three shillings, and for the same, when empty, the sum of two shillings and four pence; for a loaded wagon, with two horses, two shillings and six pence, and for the same, when empty, two shillings; for every chaise, riding chair, cart, or other two-wheeled carriage, with two horses, the sum of one shilling and ten pence, and for the same, with one horse, the sum of one shilling and six pence; for every sleigh or sled, with four horses, the sum of three shillings, and for the same, with two horses, one shilling and six pence, and for the same, with one horse, the sum of one shilling and two pence; for a single horse and rider, the sum of six pence; for every horse, the sum of five pence; for every foot passenger, the sum of one penny; for every head of horned cattle, the sum of four pence; for every sheep and swine, the sum of one penny."

The financial struggles in which many of these enterprises were involved is illustrated by the fact that of one of the early bridges across the Delaware at Easton, Pennsylvania, the History of Lehigh Valley says: "The original act of incorporation was passed by the legislature of Pennsylvania on March 13th, 1795, and by the legislature of New Jersey on the 18th of the same month. The stock was divided into shares of $100, and the company was to be incorporated as soon as one hundred shares of stock should be subscribed by twenty-five persons or more. Nearly half of the stock subscribed was paid in between the years 1795 and 1799, and a large quantity of material was procured, but the building did not progress until 1803, when the late Samuel Sitgreaves took it in hand, and assumed the active superintendence of its affairs, and to his care and attention much of the credit is due for the present prosperous state of the finances of the company. The whole cost of the bridge was $61,854.57. The amount of stock actually subscribed for was 297 shares, amounting to $29,700. This, in connection with the proceeds of a lottery authorized by law, and amounting to $12,500, was paid upon the cost of the bridge, leaving the company in debt $19,654.57. The bridge was ready for crossing in October, 1806, but was not completed until May, 1807. The tolls for the six years following its completion were devoted to the payment of the above debt."

BRIDGES IN PENNSYLVANIA.

Pennsylvania became noted, early in the present century, for the number of her bridges. From a report on roads, bridges, &c., read in the Pennsylvania senate, March 23d, 1822, the following (exclusive of those erected in Philadelphia) are selected as the oldest bridges mentioned, with the dates of the incorporation of the companies by which they were built: Bridge over the Susquehanna, four miles below Wrightsville, 1793; over the Delaware, at Easton, 1795; over the Lehigh, near Bethlehem, 1797; over the Delaware, at Trenton, 1798. The following were some of the most important bridges which followed the above: Bridge over the Susquehanna, at Wilkes-Barre, 1807; Northumberland, 1809; at Columbia, 1809; at Harrisburg, 1809; over the Monongahela, at Pittsburgh, 1810; at Brownsville, 1810; over the Allegheny, at Pittsburgh, 1810.

A notable bridge in its day was the bridge built of stone at the crossing of the Reading turnpike over the Perkiomen creek in Montgomery county, about seven miles from Norristown, in 1798–99. The bridge consisted of several arches, and entailed a heavy expenditure upon the county which undertook the work. A patent iron, chain suspension bridge, over Jacob's creek, in western Pennsylvania, was built in 1801, by William Finlay. Two similar bridges were built near Brownsville a very short time afterward of 112 and 120 feet spans.

BRIDGE-BUILDING IN VARIOUS PORTIONS OF THE UNION.

With approximate rapidity bridges were constructed over important streams in a number of the eastern and middle and some of the southern states during the early portion of the nineteenth century. A number of the solid and substantial bridges over streams of greater magnitude than the smallest sizes which required bridging, and yet not sufficiently wide or deep to necessitate long wooden spans, were constructed of stone, the masonry and arches being of excellent workmanship. Soon after the close of the Revolutionary War Thomas Paine invented an iron bridge, and a company was chartered for the purpose of erecting a structure, which would accord with his designs, over the Schuylkill at Market or High street, in Philadelphia. But the project proved unsuccessful, probably on account of the difficulty of procuring the necessary capital, and Paine soon afterwards went abroad, where his plans for an iron bridge attracted considerable attention in England and France.

PROGRESS IN BRIDGE-BUILDING.

The advances made in the art of bridge-building in the United States, and the immense amount of labor performed in providing improved means of crossing the numerous streams and rivers of the country, form one of the most brilliant and important chapters in its industrial history. Independent of the mighty strides made in connection with railway construction, there were many other notable achievements. Up to 1845 the bridges throughout the country were usually built of wood, wood and iron combined, or of stone, a few of chains. They were all generally of comparatively short spans, wood was the principal material used, and nearly all the important bridges were for highways to be used in foot, horseback, and wagon movements.

Among the prominent bridge-builders of the first quarter of the nineteenth century, Louis Wernwag gained great credit for the extraordinary cheapness, excellence, durability, and length of the spans of his wooden bridges. His bridges over the Delaware and the Schuylkill were justly famous.

The bridge originally built for the Philadelphia and Columbia Railroad over the Schuylkill was probably the best specimen of wooden bridge-building ever constructed.

The longest stone arch in the world is said to be Cabin John bridge on the Washington aqueduct, 190 feet above the stream below, and 220 feet span.

The first bridge over the Delaware river at Trenton, was finished in 1806, and was considered at the time the finest wooden bridge in the world. It was 1,100 feet long and stood on five arches.

The bridge across the Susquehanna at Harrisburg, resting on a large island in the middle of the river, was built in 1817 by a celebrated bridge architect of that day named Theodore Burr. It is 2,876 feet long and cost $155,000—more than half subscribed by the state. A bridge by the same architect at Columbia, about twenty miles lower down, was 5,960 feet long, or more than one mile, and was erected by a company supported by the state in 1814, at a cost of $232,000.

The first patent ever granted by the United States patent office, of which a record is now preserved, for a truss bridge, was issued to Theodore Burr, on April 3d, 1817. Some of the features of his design had previously been applied in this and other countries, but Mr. Burr's patented devices were extensively used and adopted on a number of the early railway bridges of Pennsylvania and other states.

A number of bridge patents had, however, been issued previous to the Burr patent, which were destroyed by the fire of 1836, the transcripts of which could not be obtained. One of these was granted to Timothy Palmer, of Massachusetts, on December 17th, 1797, and the superstructure of the first permanent bridge at Market street, Philadelphia, was built in accordance with its design. Bridge patents had also been granted before 1817, to Burr and Wernwag. The advances typified by these patents and a number which succeeded them, in connection with truss-bridges, have practically revolutionized and immeasurably improved the main portion of the bridge building of the United States. One of the most famous and extensively used of the truss-bridges of later design is the Howe truss bridge. Another famous American bridge inventor and constructor was Squire Whipple, and one of the earliest iron bridges in this country was erected in accordance with his designs.

A FEW WIRE SUSPENSION BRIDGES,

containing a comparatively small amount of material, and, therefore, liable to a considerable amount of swaying, were constructed at a comparatively early date. At a later period structures of this description gained considerable magnitude and renown, but the great cost of lengthy and solid wire bridges has prevented their general use. The first American wire bridge of considerable size was that erected at Fairmount, Philadelphia, in accordance with plans furnished by Charles Ellet, jr. It was opened for travel in the spring of 1842, and was erected on the site of the wooden bridge built by Louis Wernwag in 1818, and which had been destroyed by fire, a fate that befell so many of the wooden bridges that the desirability of using less destructible material was generally recognized.

A very large proportion of all the great American bridges constructed of late years were intended mainly or exclusively for railway use, but the wire suspension system, in its application to miscellaneous traffic, was developed up at a few points to the highest rank, in some respects, that bridges of any kind have ever obtained.

This result is largely due to the remarkable skill displayed by John A. Roebling and his son, Colonel Washington A. Roebling. After constructing wire suspension bridges of unprecedented magnitude and utility at Pittsburgh and near Niagara Falls, Mr. John A. Roebling commenced the crowning work of his life, which was finished under the supervision of his son. It was the famous Brooklyn bridge over the East river, which connects the cities of New York and Brooklyn. The total cost of this structure was about $15,500,000, and, exclusive of land damages and interest, it cost about $7,000,000. Its completion was formally celebrated on May 24th, 1883.

THE BROOKLYN OR EAST RIVER BRIDGE

consists of a central suspended span of 1,595 feet 6 inches length between central towers, and two side spans, also suspended, each 930 feet long. The approaches increase the total length to about one and one-sixth miles. The ends of the two cables are anchored in two masses, containing a total of 26,000 cubic yards of masonry. These masses are each about 119 feet by 132 feet at the base, and 89 feet high. The piers at either side of the river rise to a height of 271½ feet above mean high tide. Underneath the central span a space of 135 feet is left for the passage of vessels, so as to avoid interruption of navigation by all craft except those using unusually tall masts. Great difficulty was experienced in obtaining a reliable foundation. Work on the Brooklyn caisson was begun November 1st, 1869, and on the New York caisson on September 6th, 1870. The bridge presents five parallel avenues, each about 16 feet wide. The two outer ones are used by vehicles; the central one, elevated above the rest, by pedestrians; the two intermediate ones by street cars, propelled by continuous cables, operated by steam engines located at the termini. It has been estimated that the capacity of the bridge would permit the passage of 80,000 persons in an hour on the cars, 45,000 pedestrians in an hour on the promenade, and 1,500 vehicles in an hour on the driveways.

COMPARISON WITH OTHER BRIDGES.

	Feet.
Chelsea, suspended	700
Cincinnati and Covington (over the Ohio), suspended, built in 1867	1,067
Clifton (over Niagara river), suspended	1,268
Friborg, built 1832, suspended	870
Hungerford, suspended	1,350
Kieff, suspended	2,562
Menai, built 1819-25, suspended	1,050
Niagara, built 1855, suspended	2,220
Pesth, built 1840-49, suspended	1,262

NOT SUSPENDED.

	Feet.
Victoria (over St. Lawrence river), wrought iron	9,437
Bombay (Madras)	3,730
Boyne, at Drogheda, wrought iron	1,760
Lisbon Aqueduct, stone	3,805
Louisville, Ky	5,310
Maintenon Aqueduct, stone	16,367
Harlem Aqueduct, stone	1,450
Montpelier Aqueduct, stone	3,217
Parkesburg, W. Va., iron	7,045
Potomac	5,300
Quincy (over the Mississippi river), iron	3,200
Omaha (over the Missouri river)	2,800
Stockport, stone	1,792
Strasburg, stone	3,390
St. Charles, Mo., iron	6,536
Susquehanna, stone	3,500
Albany, N. Y., extreme length	4,800
Albany, N. Y., double track railway bridge (largest draw-span in the world)	1,400
Vistula river (Germany), iron	2,750
Firth of Tay, length nearly two miles, or	10,521

It is probably on account of the great cost of the Brooklyn bridge, and the financial arrangements it necessitated, that in an era when the general movement of the country is toward the abrogation of tolls on highway bridges, especially those located near large towns or cities, a charge was imposed for the use of the edifice that connects the largest city of the continent with a very populous adjacent municipality. Opposition to these tolls has been manifested by some of the bridge trustees and many citizens, and cogent reasons given for their abrogation. The tolls established at the outset were as follows:—

THE BRIDGE TOLLS.

	Cents.
1 horse or horse and man	5
1 horse and vehicle	10
2 horses and vehicle	20
Foot passengers	1
2-horse trucks or wagons	30
Cattle, each	5
Sheep and hogs, each	2

INTRICACIES OF THE ART OF MODERN BRIDGE BUILDING.

In an address delivered at the celebration of the opening of the Brooklyn bridge, the leading orator, Hon. Abram S. Hewitt, said:—

"In no previous period of the world's history could this bridge have been built. Within the last hundred years the greater part of the knowledge necessary for its erection has been gained. Chemistry was not born until 1776, the year when political economy was ushered into the world by Adam Smith, and the Declaration of Independence was proclaimed by the Continental Congress, to be maintained at the point of the sword by George Washington. In the same year Watt produced his successful steam engine, and a century has not elapsed since the first specimen of his skill was erected on this continent. The law of gravitation was indeed known a hundred years ago, but the intricate laws of force which now control the domain of industry had not been developed by the study of physical science, and their practical applications have only been effectually accomplished within our own day, and indeed, some of the most important of them during the building of the bridge. For use in the caissons, the perfecting of the electric light came too late, though happily in season for the illumination of the finished work.

This construction has not only employed every abstract conclusion and formula of mathematics, whether derived from the study of the earth or the heavens, but the whole structure may be said to rest upon mathematical foundation. The great discoveries of chemistry, showing the composition of water, the nature of gases, the properties of metals, the laws and processes of physics, from the strains and pressures of mighty masses to the delicate vibrations of molecules, are all recorded here. Every department of human industry is represented, from the quarrying and cutting of the stones, the mining and smelting of the ores, the conversion of iron into steel by the pneumatic process, to the final shaping of the masses of metal into useful forms and its reduction into wire so as to develop in the highest degree the tensile strength which fits it for the work of suspension. Every tool which the ingenuity of man has invented has somewhere, in some special detail, contributed its share in the accomplishment of the final result.

'Ah! what a wondrous thing it is
To note how many wheels of toil
One word; one thought can set in motion.'

But without the most recent discoveries of science, which have enabled steel to be substituted for iron—applications made since the original plans of the bridge were devised—we should have had a structure fit, indeed, for use, but of such moderate capacity that we could not have justified the claim which we are now able to make, that the cities of New York and Brooklyn have constructed, and to-day rejoice in the possession of, the crowning glory of an age memorable for great industrial achievements."

IMPORTANCE OF PUBLIC-ROAD IMPROVEMENTS.

THE poor condition of the common roads of the country, and the failure to secure good highways through the efforts of turnpike companies, partly on account of the extent to which all lengthy land movements are made on railway routes, is attracting much attention in various localities, and several plans for improving the existing road systems have in some states been adopted. One of the most practical, in old communities, is for the authorities of populous centres to buy all the stock of turnpike companies, make the turnpikes free highways, and keep them in a reasonably good state of repair. Boston was one of the first cities to adopt this expedient on an extensive scale, and it has since been applied to some of the turnpikes contiguous to Philadelphia and other cities. Various plans have been proposed, and to some extent adopted in different states. One of the most comprehensive is probably that in force in Ohio. It provides for the construction of free turnpikes in all counties that are disposed to favor such improvements.

A great question in connection with all such matters is "who shall bell the cat?" The utility of good roads is appreciated by every person who is obliged to travel or transport. But some of those who would derive a large amount of direct benefit from improvements of highways would oppose all efforts to oblige them to pay their legitimate share of the necessary expenses, and many persons who are only benefited indirectly would manifest decided hostility to costly improvements paid for out of a fund raised by taxation. There is also a doctrine, which has often been ignored in connection with the construction of railways in the United States, and too often been overstrained in its application to common roads, that the cost of a line of land carriage should not exceed the principal corresponding to the yearly amount made or saved by the road as interest. The application of this doctrine to the common roads of regions in which all the actual and prospective traffic is of very limited quantity, would go far to justify their present inferior condition, and to render it inexpedient or unprofitable to spend considerable sums in improving them.

On the other hand, there are many districts in which considerable outlays would yield a direct or indirect return, in the way of reducing the cost of transportation, that would represent a much larger sum than the cost of the necessary improvements. In determining

WHERE GOOD ROADS WILL PAY,

and where they will be unremunerative, and the extent to which improvements should be advanced, the following statements, when viewed in connection with the number of horses, wagons, and other vehicles that would probably be moved over a given line every year, may help to guide the judgment of those who wish to arrive at correct conclusions:—

Professor Sanborn, of the Missouri State College, has made a number of experiments to ascertain just what the difference is between the force required for pulling a load of given weight over different kinds of roads, and to show the value of broad tires, especially in farm work. The results are given in a pamphlet of a dozen pages, illustrated by eight diagrams.

Each load drawn was 3,695 pounds. The tires of the wheels were respectively one and a half and three inches wide, the narrower ones being considerably worn. On a blue-grass sward, moist, although but little rain had fallen within twelve days of the time of making the test, the average force required by the broad tires was 310 pounds. The narrower ones required 439 pounds, or 41.6 per cent. more than was required by the others. Professor Sanborn says:—

"Assuming the wagon to weigh 1,000 pounds, then on the broad wheels 3,248 pounds of load would be drawn as easily as 2,000 pounds on the narrow tires, except the loss from the wheels cutting deeper under the heavier load. Again, the broad wheels in the trial did not injure the turf, while the narrow wheels cut through it, an important consideration. Our teamsters, for use about the college farm, invariably choose the broad wheels. They find they are not nearly as liable to get stuck in soft places, or during rainy times.

"In a subsequent trial, on a partially dried dirt road, the broad wheels cut the road less deeply, and drew easier than the narrow wheels, the draft being for the broad tires 371 pounds, and for the narrow tires, 441 pounds, or the latter drew 12.7 per cent. heavier than the former, a net difference per ton load of 381 pounds, or 381 pounds more could be drawn on the broad wheels to the preservation of roads, as is recognized in two or three states by adjusting the rate of toll to the width of wheels, the tolls being remitted on wheels of a certain width. The difference of draft above recorded disappears on good roads.

"In the tests for ascertaining the difference in draft on good and poor roads ordinary narrow tires were used. The road had a gravel bed. The first pull was up a grade 1 foot in 28 feet, and the draft was 310 pounds. This test was made on grass, and shows that narrow tires on grass, a few days after a rain, are equivalent to a draft up a hill of more than 1 foot rise to 28 feet.

"The second pull was on a flat at the top of the above grade, and drew on a draft of 118 pounds. This should enforce the importance of avoiding hills, and of reducing grades, when practicable, by leveling. The net load drawn would be hardly one-third as much up this mild grade as on level ground. In addition to this loss, there is the further loss of capacity of a horse to draw up hill. It is well known that the structure of the horse is such that he works to a disadvantage up a grade. On level ground man power is as 1 to 5, but up hill as 1 to 3, compared with the horse.

"The value of grades is well known to railroads, and it has sometimes caused their reconstruction or the building of competing lines, and in older parts of our country the country roads are often reconstructed at great cost for the business advantage of improved grades."

On a moist dirt road the draft was 487 pounds, or 57 per cent. more than required on a grade of one to twenty-eight feet on a gravel road, four times as much as required on a level road, and seven times as much as required on a level plank floor.

The draft registered by no means shows the actual effects on the horses, and it does not take into account the suction of the mud and the slipping of their feet, nor the extra effort required for lifting their feet over the little elevations constantly before them. Prof. Sanborn concludes by saying:—

"As we view the long periods in which traffic is suspended on our dirt roads (generally in periods when farmers are not busy), the small loads dragged into our markets, the value of which is largely absorbed by the expense of delivery; the almost universal use of the saddle horse, and the immense loads carried on the solid roads of much of Europe, in connection with the above tests, we are not likely to overestimate the profound relation of our miserably crooked and marly roads, bridgeless creeks, and hills, neither graded nor circumvented, to our system of farming, its profits and pleasures.

"From the above tests, the traffic that will warrant a $2,000 outlay per mile of unimproved roads may be approximately estimated. If by properly grading our hills and graveling our road-beds we can double the freight carried per team, we could on the basis of fifteen miles per day for a loaded team costing $3 per day, save the interest of this cost at 6 per cent. in the passage of 600 loaded teams each way."

WHAT A HORSE CAN DRAG ON DIFFERENT ROADS.

In a communication to the Engineers' Club of Philadelphia, made by Rudolph Hering, he stated that if one horse can just pull a given load on two iron rails, it will take one and two-thirds horses to pull the same load upon an asphalt pavement, three and one-third upon good Belgian blocks, five upon ordinary Belgian blocks, seven upon good cobble stone, thirteen upon ordinary cobble stone, twenty upon an earth road, and forty upon sand.

A modern compilation of engineering maxims states that—
A horse can drag—

3	times as much	on the worst earthen road,
9	"	"	on a good macadamized road,
25	"	"	on a plank road,
33	"	"	on a stone trackway,
54	"	"	on a good railway,

as he can carry on his back.

The traction on a gravel road will be...... .... $\frac{1}{18}$ of the load.
" on a macadamized road, ruts and mud.... $\frac{1}{30}$ " "
" on a well-made pavement................ $\frac{1}{62}$ " "
" on a plank road.......................... $\frac{1}{100}$ " "
" on best railways.......................... $\frac{1}{280}$ " "

The resistance caused by ascending inclines is as below: If on a level a horse can draw 100—

Gradient	0 in 100	a horse	can draw	1.00
"	1 in 100	"	"	0.90
"	1 in 50	"	"	0.81
"	1 in 45	"	"	0.76
"	1 in 40	"	"	0.72
"	1 in 30	"	"	0.64
"	1 in 25	"	"	0.52
"	1 in 20	"	"	0.40
"	1 in 10	"	"	0.25

A horse can drag with the force of 120 pounds continuously and steadily at a walk; hence it can draw at a walk on a level stone road 120 pounds×34=4,080 pounds, or 1 ton 16 cwt. 48 pounds.

The traction of a carriage is to its weight on a stone pavement as 1 : 68; on a good macadamized road 1 : 49; flint foundation road 1 : 34; on a gravel road 1 : 15; on a sandy road 1 : 7.

PROPOSED LEGAL PROVISIONS FOR IMPROVED ROADS.

There are few, if any, populous districts in which the sum saved annually in reductions of the cost of transportation and increase of accommodations and conveniences, by marked improvements of the public highways, would not exceed the interest on the cost of construction and the expense of repairs. if they were made in a skillful and economical manner. But various popular, legal, and engineering questions must be decided wisely before the best results can be attained. Who shall pay for good roads? How shall they be constructed? Under what system shall repairs be managed?

There are comparatively few districts in which passably good roads have ever been built by the public authorities, and since plank roads and turnpikes have generally ceased to be remunerative investments, few companies would care to embark in similar enterprises with a prospect of inevitable financial failure. The chief reliance, unless some new modification of corporate arrangements is devised, must apparently be upon public appropriations. A wide field for discussion might be opened in regard to the extent to which the Federal Government should aid states, or states should aid counties, or counties should aid townships, but present indications favor the adoption or continuance of systems under which the principal burden of constructing and maintaining the roads of each small community must be borne by its own tax-payers. One of the most decided changes of the last half century has been towards a diminution of the number of roads and road projects that would be likely to receive assistance from state or county treasuries. Wherever the fact is clearly established that each town, township, or city must defray the entire cost of constructing and maintaining its own highways, the nature of the improvements perfected will be largely affected by due regard for the substantial interests of their tax-payers, and the extent to which enlightened views of their interests prevail.

There is such a wide diversity in the needs and condition of the different counties of any state, and even of the different townships of many counties, that any general state law, to be universally acceptable, must leave wide margin for divergent action. Some of the plans proposed, or tried, are as follows:—

In Ohio a free turnpike, or graveled road improvement law, was passed about 1863, and under its provisions about 4,000 miles of road have been built. Twenty years later more than one-half the counties in the state were without free pikes, and in many counties there were no improved roads of any kind. In 1883 Warren county took the lead, with 624 miles; then follows Miami, with 500; Shelby, 326; Montgomery, 300; Logan, 285; Madison, 265; Hardin, 250, and so on down the scale to Jefferson county, which foots the list with four miles. The average cost per mile for construction runs as follows: Hamilton county was the highest, at $6,228 per mile; next Scioto county, $3,448; then Sandusky, $3,000; Shelby, $2,772; Hardin, $2,400; and the lowest is Paulding county, $800. The cost of repairs in counties where the work was not done under the supervision of the township trustees, in 1882–83, was highest in Scioto county, being $104; Miami, $70; Sandusky, $57; Hardin, $44; Shelby, $30; Anglaize, $23; and the lowest in Madison county, at $15 per mile. The average cost per mile of construction for the state is about $1,800, making a total cost of construction $7,200,000, while the average cost per mile of repairs was about $27¼, which represents an annual expense for repairs amounting to $109,000.

In Pennsylvania improved methods have often been agitated, and one of the results was the presentation in the state senate at the session of 1885, of a bill proposing radical changes in the road laws of the state—in effect repealing all existing laws and providing for a general public road system throughout the state. The following are the main provisions:—

1. The establishment of a State Department of Public Roads, presided over by a State Supervisor who must be a competent engineer, appointed by the Governor.

2. A County Road Supervisor of skill and experience in road making, for each county in the state, elected by County Conventions of District Road Overseers.

3. A Board of Road Overseers for each township, borough, or city, elected by a popular vote, on the plan of minority representation in each district.

4. A District Road Supervisor, or Road Master, for each district, to be chosen by the respective Boards of District Overseers.

It was further provided in this bill that the state shall appropriate one million of dollars, to be apportioned among the several districts, as the state appropriation to public schools is now apportioned—provided, that each district must levy and collect a road tax, as school taxes are now collected, at least equal in amount to its quota of the state appropriation, otherwise the latter is to be withheld. It also authorizes boards of district overseers, on certain conditions, to levy and collect special taxes, or to borrow money, to purchase road rollers for their districts, and to meet other extraordinary expenses.

In Illinois bills have been presented favoring an annual appropriation of about one million of dollars, to be divided among the counties or districts, and to establish two distinct and separate road and bridge systems, each complete within itself, the one cash, the other labor. The cash system is the law until a town votes to go into the labor system, which it may do on petition of twenty-five legal voters.

ROADS RADIATING FROM RAILWAY STATIONS.

A discussion of general systems of road improvement, by Mr. S. B. Fisher, suggests that special efforts should be directed to the improvement of roads radiating from railway stations, inasmuch as they are the thoroughfares on which nearly all movements are made, and in this connection the following description is given of the practical influence of railway improvements on many sections:—

"Let us glance at a railroad map. Here runs the railroad through a tier of farms. On these farms it will burn the fences, kill the sheep, and keep the people awake o'nights. Just outside of this tier of farms, for two or three miles on each side, there are people living, who have all the advantages of railroads, who are linked with the whole world, and can have untold material comforts. Back of these there is another strip of land, on which the people enjoy these advantages in a lesser degree, and then back of this another, and so on, until the benefits of railroads are not felt. It is probable that the influence of railroads is not directly felt much beyond a distance of ten miles on either side. Not only this, but their benefits are dispensed only along this strip of country at those points called *stations*. These stations are often not very frequent at the present time, and the tendency on leading railroad lines, with heavy traffic, seems to make them still further apart. It is very probable that distances of from six to ten miles between regular stations would contribute very considerably both to economy in the equipment and to economy and safety in the operation of railroads. On leading railway lines it is difficult to get new connections for local traffic. Thus the influence of railroads on the country is confined to *nuclei*, of which the railway station is the centre. In fact, the railway system has taken up *part* of the primitive public-road scheme, that part which was assigned to the national, state, and partly to the country roads, or transportation to great distances, and has carried it far beyond the dreams of the originators. It has left the local transportation question untouched, except incidentally."

METHODS OF ROAD CONSTRUCTION.

Of the methods of construction much has been written, and it is to be regretted that a large proportion of the road making and repairing of the country has not been conducted wisely or economically. The blunders made in England before the labors of McAdam and Telford were commenced in that country have been repeated, and are now being constantly repeated, in many portions of the United States. Effective reforms can scarcely be hoped for before roads are placed under enlightened and vigilant supervision.

John Loudon McAdam spent a number of years and considerable money in investigating roads and road systems. He substantially agreed with all engineers in the opinion that a dry foundation was an indispensable requisite, but he differed from many of them in regard to plans to secure it, the size and quantity of stone or "metal" used as covering material, and the degree of convexity that should be adopted. His labors began to attract general attention in England about 1819, on account of the success which had attended his efforts during the three preceding years, to improve the condition of 148 miles of turnpike roads which had been placed under his charge.

THE MCADAM SYSTEM.

A brief description of his system embraces these statements: "Instead of producing a peaked roof-like mass of rough soft rubbish, he got a flat, smooth, and solid surface. In lieu of a road 4½ feet through, he made one of at most ten inches in thickness; and for rocks and boulders he substituted stone broken small. His leading principle was that a road ought to be considered as an artificial flooring so strong and even as to let the heaviest vehicle pass over it without impediment. Then people began to hear with wonder of roads thirty and forty feet wide rising only three inches in the centre; and he propounded the extraordinary heresy that a better and more lasting road could be made over the naked surface of a morass than over the solid rock. Another of his easy first principles was that the native soil was more resistant when dry than when wet, and that, as in reality it had to carry not alone the traffic but the road also, it ought to be kept in the condition of greatest resistance; that the best way of keeping it dry was to put over it a covering impervious to rain—the road, in fact; and that the thickness of this covering was to be regulated solely in relation to its imperviousness, and not at all as to its bearing of weights, to which the native soil was quite equal. Instead of digging a trench, therefore, to do away with the surface of the native soil, he carefully respected it, and raised his road sufficiently above it to let the water run off. Impermeability he obtained by the practical discovery that stones broken small and shaken and pressed together, as by the traffic on a road, rapidly settled down face to face and angle to angle, and made as close a mass as a wall. Surprise followed surprise. Roads which were mere layers of broken stone, six, four, and even as little as three inches in thickness, passed through the worst winters without breaking up, while, as the coachmen used to say, they 'ran true; the wheel ran hard upon them, it ran upon the nail.' Commissioners could not believe their eyes when they saw new roads made for less than it had cost them yearly to repair their old ones. When an old road was given into McAdam's charge he often made a new one of it for £88 a mile, while round London the cost of annual repairs had been £470 a mile. For he knew that the roads—such had been the ignorant waste—generally contained materials enough for their use for several years if properly applied. Unless the road was hopeless, he went to work in a practical, cheap way—first cutting off the 'gridiron' of ruts in the centre to a level with the bottom of the furrows; then 'picking' the road up to a depth of four inches; removing all the chalk, clay, or mud; breaking the large stones small, and simply putting them back again; and one of his directions to his workmen was 'that nothing is to be laid on the clean stone on pretence of binding.' But too often the road was so bad, as at Egham, that it had to be removed to its foundations. For the repairs of his roads, when once made, he always chose wet weather, and 'loosened the hardened surface with a pick' before putting on the fresh broken stone; things familiar to us now, but paradoxes then to all the confraternities of the roads. In this way he had the greatest success with the freestone near Bath, and on a road out of Bristol towards Old Down, where everybody had always said a good road would never be made with the material available, this impossible road of eleven miles, which the Postmaster-General, as a last resource, was about to indict, he perfected in two months, in 1816, for £55 a mile. Indeed, as to materials, they were to some extent a matter of indifference to him, provided they were stones and stones only. Flint (Essex and Sussex), he said, made an excellent road, if only broken properly small; limestone (Wilts, Somerset, and Gloucester) consolidates soonest of all, but is not the most lasting; the pebbles of Shropshire and Staffordshire were also good, and the beach-pebbles of Essex, Kent, and Sussex were some of the best materials in the kingdom; but the whinstone or granite of the north and of Scotland he pronounced the most durable. Even in the breaking of stones McAdam made a revolution. He saw that able-bodied men standing up with heavy hammers wasted the greater portion of their strength. He made his stone-breakers sit, so that all the force of the blows took direct effect on the stone; and the result was that he found small hammers did the work perfectly well, and thus was enabled to confine it to old men past hard labour, women, and boys, which reduced the cost of the broken stone by one-half. The size to which the stone should be broken he determined in a practical way by the area of contact of an ordinary wheel with a smooth road. This he found to be about an inch lengthwise, and, therefore, he laid it down that 'a stone which exceeds an inch in any of its dimensions is mischievous'—that is to say, that the wheel in pressing on one end of it tends to lift the other end out of the road. In practice he found it simplest to fix a weight of six ounces; and his surveyors carried about scales to test the largest stones in each heap. He would allow no large stones even for the foundation of his roads, for he found they constantly worked upwards by the pressure and vibration of the traffic."

THE TELFORD SYSTEM

makes more elaborate provisions for the foundation of a road, and differs in some other respects. He advocated a paved foundation, generally made in a manner similar to that described in the following extract from one of his specifications

VARIOUS STYLES OF BAD ROADS.

for a portion of the Holyhead road: "Upon the level bed, prepared for the road materials, a bottom course, or layer of stones, is to be set by hand, in form of a close, firm pavement. The stones set in the middle of the road are to be seven inches in depth; at nine feet from the centre, five inches; at twelve feet from the centre, four inches, and at fifteen feet, three inches. They are to be set on their broadest edges lengthwise across the road, and the breadth of the upper edge is not to exceed four inches in any case. All the irregularities of the upper part of the said pavement are to be broken off by the hammer, and all the interstices to be filled with stone chips, firmly wedged, or packed by hand with a light hammer, so that, when the whole pavement is finished, there shall be a convexity of four inches in the breadth of fifteen feet from the centre."

The advantages claimed for a foundation of this description are that it is firmer and less elastic than the best foundation of common earth; that it will carry greater loads without damage, and that the bottom stones, thus set, assist in the drainage, by allowing the water to pass through them. It must be understood, however, that if the large stones are not firmly wedged they will probably work up to the surface.

The process of laying a very expensive short road, built in partial accordance with the Telford system, in the vicinity of Philadelphia, is described as follows: "The first layer is slag or cinder from blast furnaces, which is set on end to the depth of nine inches, then a layer of broken limestone three inches thick, when an enormous steam roller is again run over this layer, when another covering of stone is placed upon it, which is again rolled, and a finishing touch of fine stone placed over the whole, and again rolled. The road when completed will be eighteen inches thick in the centre, and tapering off at the sides to nine inches."

In the best descriptions of modern American roads constructed in large cities or their vicinity heavy steam rollers are used, and through their aid better results are attained than are achieved without similar appliances. Machinery of this kind has been steadily improved, and it not only does for roads, in the way of packing and perfecting them, what under the older systems could only be accomplished by a large amount of travel, but it greatly diminishes the danger of serious injury by creating at the outset a complete highway. This is considered a great advance.

EARLY CANAL PROJECTS.

IN the chronological order of development, turnpikes preceded canals in the completion of lines of considerable length and their extensive use, but canal and river-improvement projects were the first to attract the attention of leading citizens, and postponement of their consideration to a relatively late date was due rather to a lack of capital, and to the fact that turnpikes were cheaper per mile, than to want of faith in the utility of canals or absence of a desire to secure their completion. A few short lines were, indeed, finished, or at least advanced to a sufficient extent to be of some practical service, before any of the turnpike companies were organized. Various methods of improving water routes, by removing obstructions to navigation, were proposed during the colonial era or very soon after its close, and vigorous endeavors to promote projects for constructing several canals of considerable importance were made before the Revolutionary War. The first canal constructed within the present limits of the United States was, according to some accounts, a short line built by Lieutenant-Governor Colder, in Orange county, New York, in 1750, for transporting stone. Probably the first charter under which active operations were prosecuted was granted by an act incorporating the James River company, which was passed by the legislature of Virginia on January 5th, 1785, for the purpose of improving the navigation of the James river. The company constructed a canal around the falls of James river, extending from the city of Richmond to Westham, a distance of about seven miles, and improved the bed of the river by sluices as high up as Buchanan. This canal was subsequently enlarged and extended, mainly by appropriations obtained from the state of Virginia, and this expedient is typical of the course pursued in nearly all the early canal enterprises. In a number of instances companies commenced operations, failed to obtain the requisite means, and then applied either for state or federal appropriations, for which shares were usually given. Another of the early projects was the Dismal Swamp Canal, commenced in 1787, under a joint charter of Virginia and North Carolina, and opened in 1794. The list of owners of its stock included George Washington and Patrick Henry. It was originally designed to facilitate the movement of lumber out of the Dismal Swamp, but subsequently served more important ends by furnishing during the war of 1812–14 an inland water channel of communication, which was free from the attacks of British cruisers.

Other canals, on which active operations commenced before the present century, include the following: A charter was granted on June 25th, 1792, to "The Proprietors of the Locks and Canals on the Merrimac River," and this company opened a line in 1797, about one and one-half miles long, which provided a channel around Pawtucket falls, leading into the Concord river, and thence into the Merrimac river at Chelmsford. The Middlesex Canal Company was chartered in 1792. Active operations on this work were commenced in 1795, and continued until, after some years of effort, a work of considerable magnitude and utility was completed. The Carondelet Canal was built in Louisiana about 1794, partly as a drainage canal for the city of New Orleans. It was constructed by Governor Carondelet, and the citizens contributed a large force of slaves to aid him. A canal was built in South Carolina in 1802, which connected Charleston harbor with the Santee river. It was twenty-two miles long, and cost $720,000, but is one of the numerous canals that have been abandoned. In addition to these works, a number of others were proposed or discussed at an early period, including a work which was the forerunner of the Erie Canal, the Chesapeake and Ohio, the Delaware and Chesapeake, and the Union Canal, of Pennsylvania, a work intended to connect the Delaware and Susquehanna rivers.

THE UNION CANAL,

or forerunners of it, in the nature of projected improvements for providing an artificial junction between the waters of the Susquehanna and the Schuylkill, was probably the first project of the kind seriously discussed in the colonies. William Penn referred to the subject two centuries ago. It received some consideration before the Revolutionary War. It was chiefly on account of the importance attached to it that the following interesting historic letter was written, in 1772, by Benjamin Franklin, to S. Rhoads, who was then Mayor of Philadelphia:—

"LONDON, Aug. 22, 1772.

DEAR FRIEND: I think I before acknowledg'd your Favour of Feb. 29. I have since received that of May 30. I am glad my Canal Papers were agreeable to you. I fancy work of that kind is set on foot in America. I think it would be saving Money to engage by a handsome Salary an Engineer from here who has been accustomed to such Business. The many Canals on foot here under different great Masters, are daily raising a number of Pupils in the Art, some of whom may want Employment hereafter, and a single Mistake thro' Inexperience in such important Works, may cost much more than the Expense of Salary to an ingenious young Man already well acquainted with both Principles and Practice. This the Irish have learnt at a dear rate in the first Attempt of their great Canal, and now are endeavouring to get Smeaton to come and rectify their Errors. With regard to your Question, whether it is best to make the Schuylkill a part of the Navigation to the back Country, or whether the Difficulty of that River, subject to all the Inconveniences of Floods, Ice, &c., will not be greater than the Expense of Digging, Locks, &c., I can only say that here they look on the constant Practicability of a Navigation, allowing Boats to pass and repass at all Times and Seasons, without Hindrance, to be a point of the greatest Importance, and, therefore, they seldom or ever use a River where it can be avoided. Locks in Rivers are subject to many more Accidents than those in still water Canals; and the Carrying away a few Locks by Freshets of Ice, not only creates a great Expense, but interrupts Business for a long time till repairs are made, which may soon be destroyed again, and thus the Carrying on a Course of Business by such a Navigation be discouraged, as subject to frequent interruptions. The Toll, too, must be higher to pay for such Repairs. Rivers are ungovernable things, especially in Hilly Countries. Canals are quiet and very manageable. Therefore they are often carried on here by the Sides of Rivers, only on Ground above the Reach of Floods, no other Use being made of the Rivers than to supply occasionally the waste of water in the Canals.

"I warmly wish Success to every Attempt for Improvement of our dear Country, and am with sincere Esteem,

"Yours most affectionately,

"B. FRANKLIN."

"I congratulate you on the Change of our American Minister. The present has more favourable Disposition towards us than his Predecessor."

"*To S. Rhoads, Esq.*"

ARTIFICIAL FRESHETS.

An elaborate account of the early operations of the Lehigh Coal and Navigation Company says: "The descending navigation by artificial freshets on the Lehigh is the first on record which was used as a permanent thing, though it is stated that in the expedition of 1779, under General Sullivan, General James Clinton successfully made use of the expedient to extricate his division of the army from some difficulty on the east branch of the Susquehanna by erecting a temporary dam across the outlet of Otsego lake, which accumulated water enough to float them, when let off, and carry them down the river."

The "artificial freshets" here referred to were probably one of the first important and successful efforts made in this country to materially improve the methods of navigating interior streams, and the fact that General James Clinton was able to render essential service in the manner indicated may have had an important bearing on canal development, inasmuch as he became an earnest advocate of the construction of the Erie Canal, and inspired with his zeal his son, De Witt Clinton, whose signal triumph was only the realization of the hopes of his father.

These artificial freshets of the Lehigh Coal and Navigation Company were produced at stated intervals, and generally daily during the season of navigation, before its canal was constructed, by storing water in the pools of dams across the river, of log crib-work, filled in with stones. Wide sluices, for passing rafts and coal arks, were made in these dams, and they were readily opened and shut by one man, by means of hydraulic pressure, acting in a contrivance designed by Josiah White, which was known by the name of the "bear-trap lock." The arrangement was very simple and ingenious, and fully answered the intended purpose.

EARLY HISTORY OF AMERICAN CANALS.

A work was published in Philadelphia in 1795, entitled a "Historical Account of the Rise, Progress, and Present State of the Canal Navigation in Pennsylvania, by direction of the President and Managers of the Schuylkill and Susquehanna, and the Delaware and Schuylkill Navigation Company." Robert Morris was president of both these companies. This publication states that in 1789 a few citizens of Pennsylvania had united "by the name of the Society for Promoting the Improvement of Roads and Inland Navigation," and the number of members soon increased to more than one hundred, residing in various parts of the state. By appeals to the legislature, appropriations for a number of roads were obtained, and charters and a small amount of pecuniary assistance had been granted to the canal companies mentioned above. Work on both these projects had been commenced, and some progress had been made, but the necessity of additional capital and improved methods of procuring it was already keenly felt.

The introductory remarks explain the hopes and expectations then cherished, in the statement that by "canals a people may be supplied with grain, forage, fuel, materials for building, and also all other heavy and raw materials for manufactures, which otherwise would remain of little value at a distance from the place where they are wanted, because of the great expense commonly attending their transportation by carriages, &c., for a barge of a reasonable size, worked by two men and drawn by two horses, can transport seventy or eighty tons; which weight, by any other carriage, would have required forty men and about sixty horses. This calculation is made for the canals in England, where, by means of turnpikes, a level country and improved roads, land carriage has a great advantage over any land carriage that can, for many years, be completed throughout the greater part of the United States."

The society, in a memorial addressed to the Pennsylvania legislature in 1791, had suggested as works worthy of favorable consideration, quite a number of important projects. The list included an improvement of the navigation of the Delaware from the tidewater at Trenton Falls to Lake Otsego, the head of the north-east branch of the Susquehanna; and an improvement of Susquehanna navigation, to be connected with the Schuylkill on the east, and Ohio and the great lakes on the west.

COST OF LAND CARRIAGE IN PENNSYLVANIA IN 1791.

One of the estimates made in reference to the probable earnings of the Schuylkill and Susquehanna Canal states that "the present price of land carriage from Middletown to Philadelphia is 5s. 6d. per cwt., or for twenty tons, £110." This was presumably Pennsylvania currency, £3 being equal to $8, or £1 to $2.66⅔. The movement of twenty tons, therefore, cost $293.33⅓, or $14.66 per ton. The present distance by rail is ninety-six miles. The cost per ton per mile was about 15¼ cents.

PROVISIONS OF EARLY CHARTERS.

One of the provisions in a paper styled Heads of a Plan Suggesting the Nature of the Restrictions and the Protection that Should be Established in Connection with the System of Chartering Companies, or of Having Works Built by "Constructors Entitled to Tolls," which the legislature of Pennsylvania concluded to adopt, was as follows: "By an article in each contract, the Government shall be restrained from laying out or establishing turnpikes or toll navigations, in a second instance, during —— years, which would destroy or diminish the income or revenue of turnpikes or toll navigations which they had established in the first instance."

In a memorial addressed by the Schuylkill and Susquehanna Canal Navigation Company to the legislature, they asked for a modification of their charter or contract relating to tolls, and stated that "as by the act of incorporation, although some parts of the said canal navigation may be finished and in use before the whole distance of seventy miles can be completed, yet the company are not enabled to receive toll for that part, except at the rate of one dollar for seventy miles, or the whole distance, which is only one cent, or three-sevenths of a cent per mile, whereas the Delaware and Schuylkill Canal is allowed one-sixteenth of a dollar per mile whenever any part thereof is finished."

EFFECT OF REVOLUTIONARY WAR IN POSTPONING ACTIVE OPERATIONS.

The appendix states that the summit level of the Schuylkill and Susquehanna Canal had been examined and leveled by a committee appointed by the American Philosophical Society, but it adds that "the dark and distressing period of the Revolution necessarily suspended all improvements of this nature, in every part of America, until the glorious era of the peace and independence of the United States, when they were first resumed in the states of Virginia and Maryland, upon the Potomac, under the auspices of the illustrious Washington, during his short recess from his public labors; next in the state of Pennsylvania; and speedily afterwards, with a noble emulation of public spirit, in most of the other states, according to their natural advantages, as New York, Connecticut, Massachusetts, the Carolinas, &c."

WASHINGTON'S VIEWS AND LABORS.

The labors of Washington here referred to, had a marked influence in directing general attention to the imporance of improving the channels of communication between the Atlantic coast and the interior districts, lying west of the Allegheny mountains. Thitherward a strong stream of immigration had at last been directed. After closely hugging the seaboard during the first century and a half that succeeded the establishment of settlements in Massachusetts and Virginia, and after the strong obstacles to a fulfillment of the prophetic saying that "Westward the course of empire wends its way," which arose from Indian, French, and Spanish hostilities, had been, to a great extent, removed, the chief barriers to extensive migrations to the rich prairies of the west was the expense of transportation for surplus products from western Pennsylvania, western Virginia, Kentucky, and Ohio to available markets. For a considerable period the only resort was down the Ohio and Mississippi,—the cost of movement over the mountains being so excessive as to absolutely prohibit the sending of bulky dead freight in either direction. A vivid picture of some of the embarrassments arising from this condition of affairs, and of the danger it generated that all the inhabitants of the Mississippi valley would form new political affiliations, and thus make their settlements perilous rather than a pillar of strength to the colonies which had emerged triumphantly, but terribly exhausted, from a struggle with Great Britain, is furnished in a letter addressed by General Washington, on October 12th, 1783, to the Marquis de Chastelleux. After saying that "the flank and rear of the United States are possessed by other powers, and formidable ones, too; and how necessary it is to apply the cement of interest to bind all parts of the Union together by indissoluble bonds—especially that part of it which lies immediately west of us, with the Middle states,"—he adds these very important statements: "The Western states (I speak now from my own observation) hang upon a pivot. *The touch of a feather would turn them any way.* They have looked down the Mississippi till the Spaniards, very impoliticly, I think, for themselves, threw difficulties in the way; and they looked that way for no other reason than because they could glide quietly down the stream, without considering, perhaps, the difficulties of the voyage back again, and the time necessary to perform it, and because they had no other means of coming to us but by land transportation and unimproved roads. These causes have hitherto checked the industry of the present settlers; for except the demand for provisions, occasioned by the increase of population, and the little flour which the necessities of the Spaniards compel them to buy, they have no incitement to labor. But smooth the road and make the way easy for them, and then see what an influx of articles will be poured upon us, how amazingly our exports will increase, and how amply we shall be compensated for any trouble and expense we may encounter to effect it."

THE CHESAPEAKE AND OHIO PROJECT.

The reasons thus cogently expressed doubtless form the principal causes of the ardent devotion manifested by Washington, at various stages of his career, to the creation of practicable connection between the waters of the Chesapeake and the Ohio. Largely through his instrumentality, a charter for the construction of such a work was obtained from the states of Virginia and Maryland, and also valuable grants of land and money. This was the first important and extensive work designed to connect the Atlantic seaboard and the western states on which a vigorous commencement was made, and Washington was the first president of the company formed to prosecute that undertaking. His attention had been called, during the revolutionary struggle, to the importance of the natural advantages for securing a cheap through water route which existed in New York, but he preferred to give close attention to the project which was designed to establish such an important channel through the regions with which he was most familiar, and which he had personally explored during, previous to, and after his connection with the ill-fated Braddock expedition.

The Chesapeake and Ohio Canal, however, was too expensive an undertaking to be completed during Washington's life. Even its extension to Cumberland, like the early canal projects of Pennsylvania and New York, required many years of effort, and renewals of exertion after postponements or partial abandonment.

SLOW PROGRESS OF IMPORTANT EARLY CANAL PROJECTS.

A forcible indication of the financial and other difficulties with which the pioneer projectors had to contend is furnished by the statement that the Schuylkill and Susquehanna, subsequently called the Union Canal, eighty-two miles in length, and designed to furnish a channel between the Schuylkill river, near Reading, and Middletown, on the Susquehanna, which was located in 1762 (at an earlier period than any other canal in the United States), was not actually commenced until 1791, nearly thirty years after the original surveys were made. Four miles of the line, however, were opened in 1794, but work was suspended from 1795 until 1821, and the entire line was only completed in 1827, sixty-five years after the first surveys were made, and thirty-six years after actual work was commenced. Nor was this dilatoriness exceptional.

In 1764 the second canal survey was made. It was over the route intended to connect the Chesapeake bay with the Delaware river. In 1769 a second survey of this route was conducted under the direction of the American Philosophical Society; but work was only commenced on the Chesapeake and Delaware Canal, 13½ miles long, in 1804, and subsequently suspended. The line was relocated in 1822, and completed in 1829, sixty-five years after the first survey was made, and twenty-five years after work was commenced. The Chesapeake and Ohio Canal, with which Washington was closely identified in its early stages, and which was originally designed to furnish a practical water route corresponding very closely with the line followed by Braddock's expedition, inasmuch as the scheme contemplated a line from Georgetown, District of Columbia, to Pittsburgh, was vigorously commenced in 1828, and in 1850 180 miles of the line, leading from Cumberland to Georgetown, were opened.

There were similar delays or postponements in all the early canals of material magnitude, and only the shorter and cheaper lines, intended mainly to serve local purposes, to most of which reference has already been made, were finished in a comparatively brief period.

EARLY CANAL FINANCIERING.

POLICY OF STATE GOVERNMENTS.

THE policy adopted by several of the important states is indicated by the following statement of the general principles approved by the legislature of Pennsylvania, after duly considering the appeals and memorials made in 1791 and succeeding years by the society for promoting the improvement of roads and inland navigation, viz.:—

"That the legislature, although animated by the warmest zeal for the improvement of the country, by means of roads and inland navigation, yet could not subject the finances of the state (even if adequate) to the burden of the whole; yet they would make liberal appropriations of public money for the improvement of such roads and navigable waters, as, lying too remote from the more populous parts of the country, and the inhabitants but thinly settled, rendered it impracticable for them either to improve their own roads and waters by sub.

scriptions or the usual county taxes; and the profits of the tolls would yet be too small to induce companies to undertake the work at their own expense; but that in the more settled parts of the country, especially near the metropolis, they would be ready to incorporate companies, for the gradual and progressive improvement of roads and waters, where the tolls would be sufficient to recompense the subscribers or stockholders, and the charge would fall according to justice upon those who were to be benefited, in proportion to the use they might make of such roads and waters."

In accordance with these principles the legislature of Pennsylvania granted several charters for the formation of canal and turnpike companies and made appropriations for the construction or improvement of state roads and the "clearing and making navigable certain parts" of sundry rivers in the commonwealth. The appropriation for the improvement of rivers made in 1791 amounted to £20,270 ($2.66⅔ to the £). The proposed aid was distributed to rivers in all portions of the commonwealth, including the Delaware, Lackawaxen, Lehigh, Schuylkill, Susquehanna, Juniata, Sinnemahoning, Allegheny, French Creek, Conemaugh, and Kiskiminetas. At the same time road appropriations amounting to a considerable sum were made. In 1792 £3,000 additional river appropriations were made, and aid was granted to a number of road projects. The total river and road appropriations of 1791 and 1792 amounted to £36,160. In 1793 $14,333 were appropriated to roads. But although these river and road improvements rendered some aid to local interests they furnished very imperfect aids to the transportation requirements of the time, and a very decided advance resulted from the passage of an act of incorporation, in 1792, of the first important turnpike company organized in the United States.

EARLY AGITATION OF THE ERIE CANAL PROJECT.

Canals of considerable length were too expensive to be prosecuted with great energy in any portion of the Union before the present century, or even during the first decade of the nineteenth century. Fair beginnings had been made in a number of quarters, one of the most important being in connection with preliminary steps for the construction of a portion of the Erie Canal. Sir Henry Moore, a provincial governor, had called the attention of the legislature of New York to the importance of a connection of the Hudson with lake Erie by "an artificial river" in 1768. A private company constructed a small link in the route at a comparatively early date, and efforts had been made about 1808 or 1809 to induce the Federal Government to co-operate with the state. It was probably about this period that Thomas Jefferson made the famous remark that the canal might be finished a century later.

The slow progress that had been made at that date in connection with various canal enterprises, and the lamentable failure of a variety of financial expedients, were sufficiently discouraging to render the completion of such a gigantic undertaking as the projected Erie Canal only a thing to be hoped for as a future possibility.

TRIBULATIONS OF THE UNION CANAL COMPANY.

The financial history of the Union Canal, of Pennsylvania, the project for connecting the Delaware and Susquehanna rivers, already referred to, which was one of the earliest if not the first scheme of considerable magnitude to receive very serious attention, illustrates the difficulties that attended many of the pioneer canal projects. This company was declared to be hopelessly insolvent in March, 1885, in a legal report filed in one of the courts of Philadelphia, which recommended that it should be sold at sheriff's sale.

The Union Canal was the outgrowth of a scheme first agitated about 1760 for improving the navigation of the Schuylkill, which, after a small amount of work was done, was revived in 1771, and then made part of a project for uniting the waters of the Susquehanna and Schuylkill, officially reported to be feasible. Mainly on account of the disturbing influences arising from the Revolutionary War, this project was allowed to slumber until 1791, when it was decided that the proper plan would be to organize a company to do the work. The capital was fixed at 1,000 shares at $400 each, and the title of the company was agreed to be the Schuylkill and Susquehanna Navigation Company. The legislature passed the act of incorporation September 29th, 1791. Books for subscription were shortly afterward opened. Such was the interest and excitement that 40,000 shares were subscribed for, although there were but 1,000 to be sold. In this dilemma the managers resorted to a lottery to determine who should be the successful bidders. The chances for the prize were one in forty, and the lucky holder of the drawn number had the privilege of buying the stock at par, whilst thirty-nine others just as anxious were excluded.

The persons interested in this project were desirous to have the work very complete. It was not enough that the commerce of the Susquehanna and the fruitful counties upon that river should be brought to the Schuylkill. The banks of the latter, in 1791, were as secluded and almost as wild as they had been a century previous. Trade was conducted on the Delaware, and in order to complete the scheme it was considered necessary that a canal should be built between the Delaware and Schuylkill, so that the produce coming down the latter from the west could be carried over and landed at the wharves of the merchants of the city. To accomplish this object the Delaware and Schuylkill Canal Company was chartered by act of April 10th, 1792. Power was given to the company to take water from the Schuylkill anywhere between the mouth of Stony creek, at Norristown, and the northern boundary of the city of Philadelphia. The capital was 2,000 shares, at $200 each. The stock was promptly taken, and the company organized by the election of Robert Morris, president; Timothy Matlack, secretary, and Tench Francis, treasurer. The work was commenced in November, 1792, near Norristown Mills, and prosecuted for some years.

With Robert Morris, the famous financier of the Revolution, at the head of these organizations, they commanded such an unusual degree of public confidence that they were regarded as the leading canal enterprises of the country. Unfortunately they were overwhelmed with disaster. Either on account of errors in plans adopted, miscalculations of cost, failure to procure the necessary means, financial convulsions, or a combination of all these difficulties, they were compelled to suspend their operations after an outlay of $440,000, which was an immense sum in those days. This suspension, and an interruption of active operations on the Chesapeake and Delaware Canal, which occurred a few years later, had a disastrous or discouraging effect on all similar projects for a considerable period.

On the 2d of April, 1811, the legislature passed an act to incorporate "the Union Canal Company, of Pennsylvania." The name was chosen because the new corporation was really a union of the old Schuylkill and Susquehanna and the Delaware and Schuylkill canal companies. The preamble recited that those corporations had made strenuous efforts to carry out the objects of their charters, but had failed. They were, therefore, dissolved, and a new company formed of the stockholders of the old corporations, whose relative rights were adjusted in the new distribution of the capital.

RAISING MONEY BY LOTTERY SCHEMES.

Work was again interrupted by the war of 1812, and comparatively little was done until a mode for raising funds to continue operations was furnished by the passage of an act March 29th, 1819, granting an interest of 6 per cent. to subscribers to stock of the canal, with the understanding that the money needed for paying such interest should be derived from a lottery or series of lotteries authorized. To increase the feasibility of this scheme, the company was granted a monopoly of the right of conducting lotteries in Pennsylvania. This programme was materially strengthened by the passage of an act on March 26th, 1821, by which the state was pledged to pay any deficiency of interest which the lottery could not produce.

A power to issue lottery tickets had been part of the original scheme, and granted by an act passed April 17th, 1795, but up to 1810 the company had only realized about $60,000 from the lottery. Subsequently the lottery operations became quite lucrative and a source of great abuses.

The plan of aiding the Union Canal by giving it exclusive authority during a considerable period to establish lotteries was by no means peculiar to Pennsylvania. It seems to have been a favorite resource with adjacent states for the nominal accomplishment of similar purposes. A lengthy address, issued in Philadelphia in 1833, setting forth the evils of the lottery system, said that there were more than two hundred lottery offices in that city, and that there had been offered for sale in them during the year, tickets in 420 schemes, authorized by New York, Virginia, Connecticut, Rhode Island, Delaware, Maryland, and North Carolina. The sale of tickets in all these schemes, which represented aggregate prizes of $53,136,930, was prohibited by law in Pennsylvania, except 26 schemes for the benefit of the Union Canal, which represented prizes amounting to $5,313,056. In commenting upon these facts the address referred to said: "Thus the people of Pennsylvania have been made to contribute to the internal improvements of New York, Virginia, Connecticut, Rhode Island, and North Carolina, Maryland and Delaware, as well as to pay a large sum to a company of their own state, whose grant has expired. . . . Pennsylvania, by being the great mart for nearly all the lotteries of the United States, has reason for emphatic complaint. In defiance of all her legislative prohibition of foreign lotteries, her citizens are annually subsidized to an immense amount; perhaps for a church in Rhode Island, or a rail road through the Dismal Swamp, or for other improvements in which she has as remote a prospect of interest or advantage."

COMPLETION OF THE UNION CANAL.

Partly on account of the increased success of lottery operations, and partly on account of the material aid derived from the substantial assurances furnished by the act of 1821, the managers of the Union Canal were enabled to resume operations in that year, and in about six years from that time the work was finished, thirty-seven years after the commencement of construction, and sixty-five years after the first survey. The Union Canal was nearly eighty miles long, from Middletown, on the Susquehanna, to a point on the Schuylkill a short distance below Reading, and was adapted to the use of boats of twenty-five to thirty tons' burthen. At Middletown it was connected with the Pennsylvania Canal, leading, by various connections, to Pittsburgh and Erie, to Tioga in the north, and to the Bald Eagle, on the west branch of the Susquehanna. At Reading it was connected with the works of the Schuylkill Navigation Company, leading to Philadelphia. In 1828 the cost of the Union Canal was estimated at $1,600,000, and its small locks, and the probability that much of the business of the Susquehanna would be conducted over the projected Philadelphia and Columbia Railroad, were referred to in that year as causes likely to militate against its financial success, and these apprehensions proved to be well founded.

OTHER EARLY CANALS IN PENNSYLVANIA.

Charles Miner, writing in 1833, in describing the commencement of operations by Messrs. White & Hazard, in 1818, to improve the navigation of the Schuylkill, says:—

"The only canals in Pennsylvania, at that time in navigable order, were one of about two miles in length, at York Haven, on the Susquehanna, and one made by Josiah White at the Falls of Schuylkill, with two locks, and a canal three or four hundred yards long." Of the latter work a memoir of Josiah White says: "He bought a country place, with an unimproved water power, about five miles from Philadelphia, at the Falls of Schuylkill. Here he began his engineering operations with an effort to improve that water power. . . . Josiah White built a dam in the river Schuylkill, and a large lock, of cut stone, for passing river boats. This was the first lock built on the river, and it was not until after a very severe and expensive struggle with the water that the foundation was laid."

EFFECT OF THE COMPLETION OF THE ERIE CANAL.

A GREAT impetus was given to canal construction by the completion of the Erie Canal in 1825. Its success inspired other states with a desire and determination to build competing or connecting lines, and about the same time a number of the English canal companies reached the flood tide of prosperity. Their shares were sold at a great premium. A list of English canal stocks that had originally cost £1,525 sold in 1821 for £9,287, or more than six times their par value, and they paid dividends exceeding 31¾ per cent. per annum. From that time until 1831 about the same conditions prevailed. The stock of one of the English canals, the Chester, only 9½ miles long, which had originally cost £100, sold for £2,550, and paid a dividend of £180, or 180 per cent. on the first investment. In 1832 the stock of the Schuylkill Navigation Company, of Pennsylvania, sold at an advance of 100 per cent. on the original price of shares. At a later period their stock rose to three and a half times its par value.

With state pride aroused and high hopes of corporate gains awakened a canal craze became inevitable. Captain Basil Hall, of the British navy, in his travels in North America in 1827 and 1828, after speaking in glowing terms of the numerous advantages derived by New York from the completion of the Erie Canal, directs attention to the losses that were likely to be inflicted by impracticable and unprofitable schemes warmed into life by the success of the New York canal. He says:—

"Property of every kind has risen in value, as might have been expected, in all those parts of the country through which the (Erie) canal passes, and a vast increase, both of exports and imports, has taken place in those sections of the state which lie between the Hudson and the lakes, all tending to increase the wealth and importance of the state of New York. But the example of this successful experiment *has, I suspect, done some mischief in the rest of the American states;* for it has set agoing a multitude of projects, many of which, I am convinced, can never answer any good purpose, except to such speculators as may have sold their original shares at a premium, and then backed out of the scrape, pretty much as many of the joint stock company jobbers did in England in 1825."

He thought Ohio was more fortunate, and that her canal system was likely to be very effective. He said that her inhabitants had made judicious efforts "to take advantage of their peculiar situation, and to co-operate with rather than rival their sister state. By means of canals, stretching from the very centre of that fertile region, they can now (1827–28) send their produce to lake Erie, from whence it may enter the grand canal at Buffalo, and so find its way to Lockport, Rochester, and Albany, and from thence its course to the sea at New York, down the Hudson, is an affair of a few hours. On the other hand, if the southern market is deemed preferable by the inhabitants of the state alluded to, they may send their produce by canals into the river Ohio, which joins the Mississippi, and thus it will float swiftly down to New Orleans."

UNPROFITABLE CANALS.

Although some important works had been commenced and a few had been finished before the completion of the Erie Canal, yet largely on account of the impetus given by its early triumphs and the success of a few canal companies, the work of construction was prosecuted with great vigor during the period from 1825 to 1840. A summary of the length of the lines finished and the financial results is furnished in the following extract from the United States Census Report for 1880 on Agencies of Transportation:—

"Adding together the totals of operating and abandoned canals, we have a grand total of 4,468 miles of canals, costing approximately $214,041,802. Of these, 1,953 miles are now abandoned, and a large portion of the remaining 2,515 is not paying expenses. This is largely due to railroad competition. All the canals in the New England states are abandoned for commercial purposes. The Middlesex Canal was, perhaps, the most successful up to the time of the construction of the Boston and Lowell Railroad in 1835, and it paid expenses and a dividend of about 6 per cent. for a number of years. The Oxford and Cumberland Canal, costing a moderate sum, did a fair business previous to the construction of the Portland and Ogdensburg Railroad. The Blackstone Canal, in Massachusetts and Rhode Island, passing through a rich region of country abounding in manufactories, was built in the best manner, but was never profitable. The Farmington and Hampshire and Hampden canals sunk $1,089,425. In New York state, 356 miles of lateral canals, costing $10,235,314, have been abandoned; in Pennsylvania 477 miles are abandoned, costing $12,745,780; in Ohio, 205 miles, costing $3,000,000, have been abandoned. Indiana, with the aid of her creditors, constructed 379 miles of canals, costing $6,325,262, all of which were abandoned upon the construction of railroads along the lines of the canals. The most enterprising and sagacious men in the country were engaged in projecting and building these canals, but their expectations with regard to them were never realized."

The following figures are taken from the official records of the year 1880, of the results of working the canals which had not been abandoned:—

State.	Mileage.	Cost.	Gross income.	Expenses.
New York	608	$68,229,416	$1,239,448	$1,090,974
New Jersey	171	10,776,353	635,108	461,762
Pennsylvania	529	37,706,645	1,562,018	588,024
Delaware	14	3,730,230	201,783	62,245
Maryland	104	11,290,327	372,616	227,277
Virginia	44	4,042,363	104,048	71,632
North Carolina	13	300,000	8,000	3,000
Georgia	25	1,907,818	8,200	14,362
Florida	10	70,000	Not returned.	
Louisiana	19	2,030,000	27,840	13,650
Texas	8	340,000	4,535	3,454
Illinois	102	6,557,681	107,605	125,601
Michigan	3	7,425,300	52,519	28,532
Ohio	674	15,022,503	214,891	223,643
Oregon	$\frac{3}{4}$	600,000	Not returned.	
Total for United States	2,515	$170,028,636	$4,538,620	$2,954,156

VARIATIONS IN THE CONSTRUCTION AND SIZE OF CANALS.

As compared with the primitive canals of some other countries, a number of the American lines represented, from the outset, a marked improvement in several particulars; but lack of capital generally prevented the construction of artificial waterways large enough to admit boats of considerable capacity, and this defect was so damaging that enlargements became necessary on nearly every work that was destined to obtain a prominent position.

An early indication of the inconveniences and lack of ability to compete with large-section canals, which would be likely to result from the methods pursued in the construction of some of the canals of Pennsylvania, is furnished by the following remarks in reference to the Union Canal, which had locks only seventeen feet wide, written in 1828: "Unquestionably, canals of small section can be made in less time, with less expense, and require less water than canals of large section, and may, therefore, be frequently more beneficial to a company than the latter, particularly if the amount of the trade, or rather of the tolls, be not influenced by the size of the canal; but to the public at large, to those using the navigation, the expense of transportation is much less on the large canal, for two men, one boy, and a horse are required for every boat of twenty-five tons. The employment of an additional horse, which will occasion but a very small addition to the expense, will be sufficient for a boat of forty-five or fifty tons. In our commonwealth (Pennsylvania) it may be thus stated:—

2 men, at 75 cents each	$1 50
1 boy, at 50 cents	50
1 horse, at 50 cents	50
	$2 50

for twenty-five tons, or 10 cents per ton for a given distance.

2 men, at 75 cents each	$1 50
1 boy, at 50 cents	50
2 horses, at 50 cents	1 00
	$3 00

for 50 tons, or only 6 cents per ton for the same distance.

"To each of these estimates must be added the toll, which will be less on the small canal. If, therefore, the increased toll (which will be necessary to pay on the large and consequently more expensive canal) be less than the amount saved in the transportation thereon, it will conduce more to the public interest to adopt it, if a sufficient supply of water can be obtained, particularly if such canal be intended to communicate with canals of large section and considerable extent."

In other words, the cost of transportation, exclusive of tolls, was nearly twice as great on a canal on which only 25-ton boats could be moved as on a canal adapted to the movement of 50-ton boats, and on this question of capacity the utility of many of the canals constructed in this country has hinged.

In determining the size or capacity of canals, one of the important questions to be considered was the difficulty of obtaining sufficient quantities of water to feed or supply large structures. The additional expense also created obstacles of grave importance during an era when capital was exceedingly scarce. The enlargements made from time to time greatly cheapened the cost of movement, and a principal cause of the marked reductions in the actual charges imposed at various periods is the economical benefits resulting from the substitution of large for small boats. Another element of economy is the substitution of steam for horse power. Reductions of tolls have also helped to reduce rates, especially where they have been so important as those made on the Erie Canal. One of the calculations is that the cost of moving one ton per mile on a large canal is $41\frac{1}{2}$ per cent. of the cost of movement on a small canal, and by enlargements and the use of steam power the cost, exclusive of tolls, has been reduced to less than three mills per ton per mile.

The advantages resulting from enlargements of canals, together with contrasts of the benefits realized or anticipated from canals with the results derived from some of the early railroads, are illustrated by the following statements:—

COST OF TRANSPORTATION ON CANALS OF VARIOUS SIZES AND ON EARLY RAILROADS.

A report of Mr. Josiah White, acting manager of the Lehigh Coal and Navigation Company, dated Philadelphia, January 12th, 1829, says:—

"Perhaps some remarks on our experience with our railroad, on which has been transported upwards of 6,000 tons, may settle the question, with some of our stockholders, who have doubted the policy of canaling the valley of the Lehigh, in place of making a railroad. I, therefore, give the cost of transportation on our railroad and also on the Erie Canal; . . . both are given *without tolls or repairs of road or canal.*

Cost of Transportation on our Railroad for the Year 1828.

Mules and horses cost	$1\frac{1}{3}$	cent per ton a mile.
Hands	$1\frac{1}{5}$	cent per ton a mile.
Repairing wagons	$\frac{2}{3}$	cent per ton a mile.
Oil for wagons	$\frac{1}{5}$	cent per ton a mile.
Total	$3\frac{53}{100}$	cents per ton a mile,

full load one way, and the whole cost divided into the distance one way only.

Cost of Transportation by the Erie Canal (Exclusive of Tolls).

For boats of 40 tons burthen, 1 cent per ton a mile; full loads one way and returning empty. Calculated as per the railroad.

Calculating on same data as above, on a boat of 67 tons, such as will be adapted to the Delaware Canal, transportation will cost $\frac{7}{10}$ of a cent per ton a mile; and for a boat of 134 tons burthen, adapted to the Lehigh Canal, $\frac{1}{2}$ cent per ton a mile; the latter being less than one-sixth the cost per mile, as per our railroad."

COST OF CANAL TRANSPORTATION.

THE average tolls on several important American canals in 1832 were two cents per ton per mile, and the cost of movement one cent, making three cents per ton per mile the sum usually paid for transporting articles which were not subjected to exceptionally high or exceptionally low tolls. These charges were cited in a memorial of the Chesapeake and Ohio Canal Company to Congress, in 1832, as the standard American rates at that time.

The tolls on the Union Canal, of Pennsylvania, in 1831 varied from half a cent per ton per mile to two cents, with the character of the article, two cents being imposed on household furniture, marble, merchandise, rosin, salt, tar, and window glass, and half a cent on clay, earth, and stone. A number of articles were charged one cent, and others $\frac{3}{4}$, $1\frac{1}{4}$, $1\frac{1}{2}$, and $1\frac{3}{4}$ cents. Similar tolls were established at the outset on the Pennsylvania state canals, but subsequently they were frequently changed.

COST OF TRANSPORTATION ON THE ERIE CANAL.

An annual report of the Auditor of the Canal Department of the state of New York contains a table showing that average charges for canal transportation for the periods named below had been as follows:—

Average from—	Up freight per ton from Albany to Buffalo.	Tolls.	Freight.	Down freight per ton from Buffalo to Albany.	Tolls.	Freight.
1830 to 1833, 4 years......	$18 65	$9 85	$8 80	$8 84	$4 74	$4 10
1834 to 1837, 4 years......	18 00	6 57	11 43	7 15	3 28	3 87
1838 to 1841, 4 years......	16 10	6 57	9 53	6 94	3 28	3 66
1842 to 1845, 4 years......	11 75	6 57	5 18	5 93	3 28	2 65
1846 to 1849, 4 years......	7 85	4 80	3 05	5 90	2 92	2 98
1850 to 1853, 4 years......	6 05	3 76	2 29	5 07	2 37	2 70
1854 to 1857, 4 years......	5 05	2 92	2 13	4 86	2 19	2 67
1858 to 1861, 4 years......	2 45	1 24	1 21	3 54	1 51	2 03
1862 to 1865, 4 years......	2 52	1 22	1 30	4 66	2 11	2 55
1866 to 1872, 7 years......	2 60	1 05	1 55	4 13	1 80	2 33

F. A. Alberger, in a letter addressed to the Senatorial committee on transportation routes, dated Buffalo, December 1st, 1873, said: "The toll-freight on a barrel of flour from Buffalo to Albany in 1830–31–32 was 55 cents; carriers' charges, average, 43 cents; in 1833, 39 cents; carriers' charges, average, 49 cents; from 1833 to 1846, 35 cents; carriers' charges, average, $36\frac{3}{4}$ cents; from 1845 to 1851, 31 cents; carriers' charges, average, $31\frac{2}{5}$ cents; from 1850 to 1858, 23 cents; carriers' charges, average, $29\frac{4}{7}$ cents; from 1857 to 1861, 15 cents; carriers' charges, average, $20\frac{1}{2}$ cents; in 1861, 19 cents; carriers' charges, average, 27 cents; from 1861 to 1870, 23 cents; carriers' charges, average, 27 cents; from 1869 to 1873, $11\frac{1}{2}$ cents; carriers' charges, average, $26\frac{83}{100}$ cents."

The Auditor of the New York Canal Department, in his report on the tolls, trade, and tonnage of the canals for 1872, gives the average sum per ton per mile received by the carrier, at 10.02 miles, including state tolls. In the same report he gives the average amount per ton per mile received by the carrier from 1856 to 1872, as follows:—

	Mills.		Mills.
1856..............................	11.10	1865..............................	10.10
1857..............................	7.99	1866..............................	10.00
1858..............................	7.97	1867..............................	9.00
1859..............................	6.72	1868..............................	8.80
1860..............................	9.94	1869..............................	9.20
1861..............................	10.08	1870..............................	8.30
1862..............................	9.59	1871..............................	10.02
1863..............................	8.76	1872..............................	10.02
1864..............................	10.15		

The average amount received by the carrier, including the state tolls for the seventeen years ended with 1872, was 9.14 mills per ton per mile, including the carriers' profits, which is an average from Buffalo to Troy, 345 miles, of $3.15 per ton, and from Buffalo to New York, 500 miles, of $4.57 per ton of 2,000 pounds. State Engineer Taylor, in his special report of 1863, on canal enlargement, makes the cost per ton per mile on the present Erie Canal 2.16 mills and 1.04 mills per ton per mile with a (projected) re-enlarged Erie Caual of capacity for boats of 600 tons.

He gives the relative cost of transportation as follows: Old Erie Canal, 4 feet water, boats 76 tons, cost 4.14 mills per ton per mile; enlarged Erie Canal, 7 feet water, boats 210 tons, cost 2.16 mills per ton per mile; re-enlarged Erie Canal, 8 feet water boats 690 tons, cost 1.04 mills per ton per mile.

Andrews' Report on Colonial and Lake Trade, published in 1854, says:—

"Previous to the construction of the canal the cost of transportation from Lake Erie to tidewater was such as to nearly prevent all movement of merchandise. A report of the committee of the legislature, to whom was referred the whole subject of the proposed work, consisting of the most intelligent members of that body, dated March 17th, 1817, states that at that time the cost of transportation from Buffalo to Montreal was $30 per ton, and the *returning* transportation from $60 to $75. The expense of transportation from Buffalo to New York was stated at $100 per ton, and the ordinary length of passage *twenty days;* so that, upon the very route through which the heaviest and cheapest products of the west are now sent to market, the cost of transportation equaled nearly *three* times the market value of wheat in New York; *six* times the value of corn; twelve times the value of oats; and far exceeded the value of cured provisions. . . . Prior to the construction of the Erie Canal the wheat of western New York was sent down the Susquehanna to Baltimore, as the cheapest and best route to market. . . .

"The rates of transportation over the Erie Canal, at its opening, were nearly double the present charges (1854)—which range from $3 to $7 per ton, according to the character of the freight."

"DISCRIMINATING" TOLLS ON THE NEW YORK CANALS.

The same work states that 1845 was the "year in which the enlarged Welland Canal first came into serious competition with the route through Buffalo. The policy of the state of New York has been not only to obtain the largest possible revenue from her canals, but also to protect her own manufactures and products against competition from other quarters; and this she has been enabled hitherto most effectually to accomplish, by levying *discriminating* tolls. Thus foreign salt was excluded from the western states by a rate of toll about twice its whole value. The toll upon this article in 1845 was three cents per 1,000 pounds per mile, or $21.78 per ton of 2,000 pounds (about three dollars per barrel), while the toll upon New York state salt was only one-thirteenth part of that upon the foreign article. In 1846 (the first year after the opening of the enlarged Welland Canal), the tolls on foreign salt were reduced one-half, and a still greater amount on New York state salt. The next year a further reduction of thirty-three per cent took place; and in 1850 the toll was again reduced one-half, so that it is now only *one-sixth* the rate charged in 1845; but it is still subject to a tax five times as great as that paid by New York state salt.

In like manner, railroad iron in 1845 paid a toll of 9 mills. In 1846 this was reduced to 5 mills; in 1850, to 4 mills; in 1851, to $2\frac{1}{2}$ mills, and in 1852, to $1\frac{1}{2}$ mills. Almost every other article of heavy goods and merchandise for up-freight has likewise undergone frequent and heavy reductions in toll on the Erie Canal since the Welland and St. Lawrence came into competition with it.

In the down trade, flour and wheat have been reduced 33 per cent.; corn and oats, from $4\frac{1}{2}$ mills to 2 mills; pork, bacon, lard, and lard oil, from $4\frac{1}{2}$ mills to $1\frac{1}{2}$ mills; beef, butter, cheese, tallow, beer, cider, vinegar, from $4\frac{1}{2}$ to 3 mills. Almost every other article of down-freight has undergone like reductions. Likewise, the discrimination in favor of pot and pearl ashes, and window glass manufactured in New York state, has been abandoned, the state retaining only a discriminating toll against salt and gypsum from other states or countries."

These reminiscences of the old way of managing state works present striking contrasts with the modern method of abolish-ing tolls on the New York canals, and appropriating money to keep them in repair or to improve them. They also suggest texts on the subject of "freight discriminations."

MOVEMENTS ON PENNSYLVANIA STATE CANALS.

The report of the Canal Commissioners of Pennsylvania for 1831 says: "Flour is now carried by the canals to Philadelphia from Lewistown, 211 miles, for 62½ cents, and from Harrisburg, 150 miles, for 40 cents a barrel; and gypsum is taken back for $3 a ton to Harrisburg, and $5 a ton to Lewistown. Therefore, the freight, exclusive of tolls, is, downwards, 14½ mills per ton per mile, and returning, 7 mills per ton per mile, or an average both ways of one cent and three-fourths of a mill per ton per mile for carriage."

The report also says: "The tolls charged on the Pennsylvania Canal were revised by the board of Canal Commissioners on the 9th of last April. *They are now as low as justice can require or prudence will warrant.* A copy of the rates of toll in tabular form, marked B, accompanies this report." It embraces the following and other rates pertaining to passengers, boats, &c.:—

Rates of toll per mile to be charged on the Pennsylvania Canal, from and after the 1st day of May, A. D. 1831:—

On ashes, leached, and manure, per ton, 6 mills; ashes, pot and pearl, per ton of 7 barrels, 1 cent, 5 mills; agricultural productions, not particularly specified, 1 cent, 5 mills; agricultural instruments and carts, wagons, sleighs, ploughs, and mechanics' tools, necessary for the owners' individual use, when accompanied by the owner emigrating, per ton, 1 cent, 5 mills; bark, in boat, per ton, 1 cent, 5 mills; in rafts, 1 cent; if ground, 1 cent, 5 mills; beef, salted, per ton of 8 barrels, 1 cent, 5 mills; brick, per ton of 500, 7½ mills; boards, planks, and scantling, reduced to inch measure, and all siding lath and other sawed stuff less than an inch thick, if conveyed in boats and scows down stream, 1,000 feet board measure, 1 cent; do., do., if conveyed in boats and scows up stream, 2 cents; the same if conveyed in rafts up or down; butter, lard, and cheese, per ton, 1 cent, 5 mills.

The toll on the following articles, per ton per mile, in cents and mills, was as follows: Clay, earth, sand, and gravel, 6 mills; charcoal, 1.5; mineral coal, 5 mills; cotton, 1.5; dry goods and merchandise, 3; deer, buffalo, and moose skins, 2; furs and peltries, except those just named, 3; household furniture, 2; grindstones, 1.5; gypsum, 1.5; groceries, 2; hay, 1; heading or pool poles for barrels or hogsheads, if transported in rafts, 1.5; hardware, 2.5; hemp and hempen yarns, 1.5; iron ore, 1; iron pigs and broken castings, 1.5; iron castings, blooms, and anchovies, 2; iron bar, rolled, slit, or hammered, 2.5; lard, pig, 1.2½; lead, white, 1.5; lath, split, 1; marble, unwrought, 1.5; marble, manufactured, 2.5; millstones and French burrs, 1; queensware and earthenware, 2.5; salt, fine, in rafts, 1.5; tobacco, not manufactured, 1.5.

The toll on the following articles, in which the ton is to consist of a specific quantity, or some other basis of charge is made, was as follows, in cents and mills: Barley, ton of 50 bushels, 1.5; beer, ton of 8 barrels, 1.5; cider, ton of 8 barrels or 2 hogsheads, 1.5; corn, Indian, ton of 40 bushels, 1.5; flour, ton of 10½ barrels, 1.5; fish, salted, ton of 7½ barrels or 14 half barrels, 1.5; heading for barrels, if carried in boats or scows, ton of 500, 7½; heading for hogsheads, ton of 400, 7½; hoop poles for barrels or hogsheads, if carried in boats or scows, 7½; lime, ton of 28 bushels, 1; liquors, except whisky and other domestic distilled spirits, ton of 2 hogsheads or 8 barrels, 2.5; oats, ton of 80 bushels, 1.5; oysters, ton of 4,000, 3; pork, salted, ton of 8 barrels, 1.5; posts and rails, 5 mills; rye, ton of 40 bushels, 1.5; rosin, ton of 8 barrels, 2; clover, flax, and other seeds, ton of 40 bushels, 1.5; staves for pipes, 7½; tar, ton of 7 barrels, 28 gallons each, 2; round and square timber, 1, if conveyed in boats, and 2 if conveyed in rafts; wheat, per ton of 40 bushels, 1.5; whisky and other domestic distilled spirits, ton of 2 hogsheads or 8 barrels, 2; wood for fuel, per cord, 1.5, if conveyed in boats or scows, and 3 if conveyed in rafts.

On all articles not enumerated above, 1.5 per ton, if passing eastward or southward, and 3 if passing northward or westward.

In August, 1834, when a large portion of the Pennsylvania main line of improvements was about getting fairly under way, Moore's Philadelphia Price Current said:—

"Only last year (1833) the papers of New York boasted in capital letters, that goods had been transported to Cincinnati, via Albany and the canal for the trifling sum of TWO DOLLARS AND FORTY CENTS (per hundred pounds); we give it in capitals, for the whole benefit of the boast shall be prominently repeated. . . . Goods are now delivered from Philadelphia at Cincinnati for ONE DOLLAR AND THIRTY CENTS!! We place this in capitals also that there may be no misunderstanding. . . . Cotton has been brought from Alabama, via the Pennsylvania Canal, and delivered in Philadelphia at a less cost than it could be sent via New Orleans!"

MOVEMENTS ON THE DELAWARE AND HUDSON AND OTHER COAL-TRANSPORTING CANALS.

On the Delaware and Hudson Canal, when its capacity was restricted to 50-ton boats, coal was carried 108 miles for $1; when the capacity increased, so as to make it available for boats carrying from 115 to 141 tons, the cost was reduced to 50 cents, or $4\frac{6}{10}$ mills per ton per mile.

John Bolton, shortly after retirement from the position of president of the Delaware and Hudson Canal, said: "On the Erie Canal and Delaware and Hudson Canal, the highest rate on merchandise, including toll, freight, and receiving and forwarding, is 5 cents per ton per mile, $1.62 for 32 miles. The Delaware and Hudson Canal is 108 miles long, their railroad 16 miles; the toll on that canal, on coal, is $1.50 for the whole distance, and on the railroad 50 cents per ton."

Jonathan Knight, in 1832, said: "With regard to the cost of transportation upon canals, there are various and conflicting statements. . . . It appears that on the Erie Canal, the cost, with boats of 40 tons burthen (exclusive of tolls), is one cent per ton per mile, with full loads in one direction and empty in the other. The information we personally obtained, in the autumn of 1830, upon the works of the Delaware and Hudson Canal Company, in relation to their canal, was, that two men, a boy, and a horse, would convey a boat, freighted with 25 tons of coal, 20 miles in a day; in October, however, owing to the want of water, the quantity carried was only 20 tons. The transportation was done by contract for $1.50 per ton; the length of the canal being 108 miles, the cost per ton per mile was $1\frac{39}{100}$ of a cent, exclusive of tolls; but they hoped to economize it to $1.25, or per ton per mile $1\frac{16}{100}$. This very well agrees with Judge Wright's statement of 'one cent to one cent two mills.' The present cost of transit, on the Lehigh Canal, in *rough arks*, is one cent per ton per mile. With a boat of 75 tons burthen, Josiah White, the superintendent, estimates the cost of transportation on the Lehigh Canal to be about ¾ of a cent per ton per mile."

In 1827 on the Schuylkill Canal, the toll charged for a through movement was $1.48, or 1½ cents per ton per mile. In an estimate of the cost of moving coal over this canal to Philadelphia in 1833, the toll was fixed at $1 and the freight charges at $1.50.

A series of calculations made in 1834 by an enthusiastic advocate of the construction of a railway leading from Wilkes-Barre to the Lehigh, for the purpose of securing a New York market for Wyoming coal, embraced the following estimates of cost of transportation at the rates then prevailing:—

10 miles railroad at 6 cents	$0 60
26½ miles canal to Mauch Chunk—toll, 1 cent; freight, ¾ cent	46½
72 miles canal to Black Eddy	1 26
60 miles Delaware and Raritan Canal (toll and freight)	94
40 miles tide to New York	40
	$3.66½

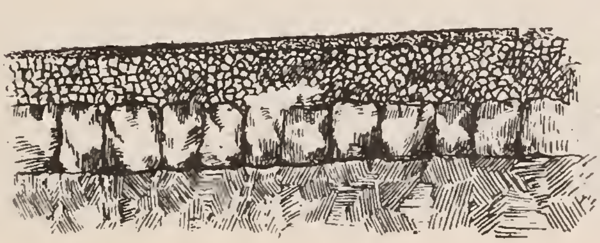
In commenting upon the future course of the coal trade he said: "Doubtless the Mauch Chunk mines have an advantage over all others; but they cannot supply the whole demand. Coal in New York will not probably be ever less than from five to six dollars a ton, and at that price we could take ours to that city."

NEW ENGLAND CANALS.

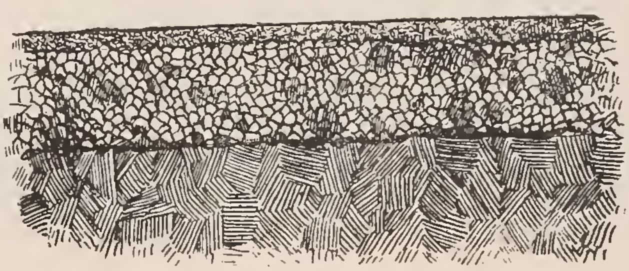
The reductions on the Erie Canal already described were, to a considerable extent, accompanied by corresponding reductions on various other canals, or they were obliged to either abandon or greatly restrict their operations. On the Middlesex

Toll Gate.

Turnpike Movements.



Telford Road System



McAdam Road System.

Canal, the first of the important New England canals, boats carried from 16 to 30 tons, and it was found that one horse could draw 25 tons on the canal as easily as one ton on the common road. The company's charter allowed a toll of one-sixteenth of a dollar per mile for every ton of goods carried in the boats, and the same sum for every ton of timber floated in rafts. The actual rates ranged from $1 to $2 per gross ton for the 27 miles from Boston to Lowell. A report on the Blackstone Canal, when work was about to be commenced in 1822, for the purpose of connecting Providence and Worcester, estimated the cost of transportation, exclusive of tolls, at one cent per ton per mile, or $1 a ton for 100 miles, while the usual cost of conveyance was $1.25 per cwt., or $25 a ton for 100 miles. The canal was 32 feet wide at the top, 18 feet at the bottom, and 3½ feet deep, with locks 10 feet wide and 70 feet long.

NEW JERSEY CANALS.

In the act incorporating the Delaware and Raritan Canal Company, passed by the New Jersey Legislature in or about 1830, the company was authorized to charge such tolls as they shall think reasonable and proper, provided they shall not exceed "the rate of four cents per ton per mile, toll, for the transportation of every species of property, nor more than five cents per mile, toll, for the carrying of each passenger, on the canal, and not more than half that rate on the feeder."

In 1848 the reported average toll on the Delaware and Raritan Canal, for 43 miles, was 68 cents per ton of 2,240 pounds, or 1⅝ cents per mile per ton of 2,000 pounds. The toll sheet required the payment of 1½ cents per ton of 2,000 pounds per mile for marble, potatoes, apples, and vegetables generally. High grades of freight paid 4 cents. For toll and transportation combined the company was authorized to charge 4 cents per ton per mile for every species of property.

On the 14th of March, 1835, an able and exhaustive report upon the

COMPARATIVE COST OF TRANSPORTATION ON EARLY CANALS AND RAILROADS,

was made to the New York canal commissioners, by Messrs.. John B. Jervis, Holmes Hutchinson, and Frederick W. Mills, civil engineers of large and varied experience.

These gentlemen reported that the cost of transportation on railroads then was 3½ cents per ton per mile, on a level road; and that this cost would be increased upon different ascending grades, in the following ratio:—

	Cents.
Ascent of 10 feet per mile	4.20
Ascent of 20 feet per mile	4.90
Ascent of 30 feet per mile	5.95
Ascent of 40 feet per mile	7.28
Ascent of 50 feet per mile	8.19
Ascent of 60 feet per mile	9.66
Ascent of 70 feet per mile	11.41

They also reported that the cost of transportation, exclusive of tolls, for a ton of 2,240 pounds on the Erie Canal, would be 1.04 cents per ton per mile; and that if the canals were reduced to a level, the cost would be only $\frac{828}{1000}$ of a cent per ton per mile.

Also: "Taking the facts we have obtained as a basis, we find the relative cost of conveyance is as 4.375 to 1, a little over four and one-third to one, in favor of canals; this is exclusive of tolls or profits."

Also: "The average tolls on the Erie Canal are less than one cent per ton per mile; assuming an average toll of one cent per ton per mile, the ratio of the entire cost of transportation and tolls is (2.5 to 1) two and a half to one in favor of canals."

The report closes as follows:—

"We are, therefore, led to the conclusion that in regard to the cost of construction and maintenance, and also in reference to the expense of conveyance at moderate velocities, canals are clearly the most advantageous means of communication. On the other hand, where high velocities are required, as for the conveyance of passengers, and under some circumstances of competition for light goods of great value in proportion to their weight, the preference would be given to a railroad.

"It may be observed in favor of railroads that they admit of advantageous use in districts where canals, for want of watei, would be impracticable. This advantage often occurs in mining districts, and sometimes for general trade, where it is necessary to cross dividing ridges, at a level too high to obtain water for their summits.

"The facts and reasonings presented, we believe, clearly show that both canals and railroads are highly important means of internal communication; that each has its peculiar advantages, and will predominate according to the character of the route, and the trade for which it is intended to provide."

It was upon this basis, and by reason of these and other similar representations, that the work of enlargement of the Erie Canal was commenced in 1835, and ultimately prosecuted to completion in 1862.

RELATIVE UTILITY OF CANALS AND RAILWAYS.

The above report was severely criticized, soon after its publication, by able engineers, who contended that the data it furnished in regard to the relation between the cost of railway and canal movements was based on experiments on a railway operated under many disadvantages. The statesmen of that day, however, were much more ready to listen to arguments in favor of canals than any views which could be presented in favor of railways, partly, it is said, because canals could be more easily understood, and partly because methods of constructing and operating canals in the direct or indirect interest of influential politicians had been established. It is, of course, now known that many railways can and do make their average movements at much lower rates than those prevailing on any of the early canals, and that there were good theoretical reasons for believing that railways could be more useful as freight carriers than any canals that are not very large is shown by the following table and comments, which form part of an argument presented to Congress, in 1832, by Jonathan Knight, in his advocacy of the Baltimore and Ohio Railroad as a rival of the Chesapeake and Ohio Canal:—

A Table Showing the Effects of a Power, or Force of Traction, of One Hundred Pounds, at Different Velocities, on Canals and Railroads.

Velocity of motion.		Load moved at a power of 100 pounds.			
		On a canal.		On a level railway.	
Miles per hour.	Feet per second.	Total mass moved.	Useful effect.	Total mass moved.	Useful effect.
2½	3.66	55,500	39,400	40,000	30,000
3	4.40	38,542	27,361	40,000	30,000
3½	5.13	28,316	20,100	40,000	30,000
4	5.86	21,680	15,390	40,000	30,000
5	7.33	13,875	9,850	40,000	30,000
6	8.80	9,635	6,840	40,000	30,000
7	10.26	7,080	5,026	40,000	30,000
8	11 73	5,420	3,848	40,000	30,000
9	13.20	4,282	3,040	40,000	30,000
10	14.66	3,468	2,462	40,000	30,000
13½	19.90	1,900	1,350	40,000	30,000

In commenting upon this corrected table, Knight says: "Seeing, therefore, that the improvements in railways and cars have been such that, with a velocity of three miles per hour, the effect is greater than on a canal, and that, at higher velocities, the effect will be vastly more decided in favor of the railway, in consequence of the resistance in the canal increasing in a duplicate ratio of the velocities, and when we also reflect upon the very great improvements which have, in the last two or three years, been made in the locomotive steam engine, and consider the paramount importance of speed and certainty to a traveling and commercial people, more especially in a country of such extended surface as the United States, and that this avenue of communication will be open throughout the year, in winter as well as summer, shall we hesitate to say that a railroad should be preferred in ninety-nine cases out of a hundred?"

PASSENGER TRAFFIC OF THE CANALS.

FOR some years there was a considerable amount of travel on the leading canals, and especially on the Erie and the main line of Pennsylvania. The following account was given a few years ago by a correspondent of the Pittsburgh Chronicle-Telegraph of

MOVEMENTS ON THE PENNSYLVANIA MAIN LINE.

A few days ago the writer called upon an old gentleman now living in Springdale, Allegheny county, who, from the opening of the canal for passenger travel in 1834, to its close in 1854, was a captain of a passenger packet. Captain J. N. Hanna is now nearly seventy years of age, but the old days on the canal are seemingly but as yesterdays to him, and there is probably no one now living who knows so much, of what was done on the canal, during the years of its existence, as he. The captain is now employing his spare moments in the construction of two models of passenger packets—the one a model of the first packet ever run on the canal, the Pittsburgh, and the other, the Philadelphia, a section boat. These models, when completed, will be placed on exhibition at expositions in different parts of the country, and will be objects of curiosity to many. The packet, Pittsburgh, was first run into Pittsburgh on the 19th of March, 1836. It was 72 feet in length, 11 feet in width, and was 8 feet in height. The interior of the boat was divided into three apartments—the cook-room, ladies' cabin, and gentleman's cabin. Along the sides were fastened swinging berths, shut off from each other by means of curtains. About twenty windows on each side gave light to the boat and several skylights also gave additional light to the interior. The boat was painted white, with its waylards red and black, and on the windows were Venetian shutters which were painted green. Add a crew of nine persons, a driver and three mules, and you have a completely equipped canal boat of fifty years ago, ready to accommodate one hundred and fifty passengers.

"You want to know something of how we traveled, do you?" said the captain. "Well, we would start from Pittsburgh at nine o'clock in the evening, and run to the end of the Western division, at Johnstown, in 28 hours, a distance of 103 miles. In that distance we would change horses thirteen times. A passenger packet left Pittsburgh every evening and generally the boat would be crowded with passengers. When we got to Johnstown, the passengers would be taken over the mountains in coaches. Half way across, the coaches would meet those making transfers from the canal on the other side, and each would turn and go back with the other coach's load. Several years after the canal was in operation the old Portage railway was built across the mountain, and section boats were then built and taken across in that way without a transfer of passengers being made."

Of passenger movements on the same route, R. S. Elliott, of St. Louis, an engineer who helped to construct the canal, writes as follows: "I have noted the advent of the stages and their drivers when our turnpike road came into use. But what is human glory, after all. The canal came, with packet boats for passengers, and where was the glory of the stage driver then?

> Gone, like the snowflake in the silver fountain,
> Or as the daylight fades o'er vale and mountain.

"For the boat captain outshone any driver that had ever held rein, or sounded his brass horn as he swept proudly round on a high trot to the tavern door. The stages still ran, and carried mails, for boats could not run in winter; but the charm had gone out of the driver. No more the expectant gatherings at the tavern portals. They were down at the canal, to greet the packet. And when the boat came gliding into the lock, and her captain, fearless on her bloodless deck, gave the sonorous order, 'Snub her!' what was Wellington at Waterloo to him? And in sooth not to be despised were those canal packets. Kitchen at the stern, table from end to end of the cabin, three square meals, and at night a double tier of shelves on either side for beds—what was all this but comfort and luxury, if not grandeur, even less than forty years ago? Eating, sleeping, and the journey still going on! What are the dining cars and the sleeping cars of that ubiquitous George M. Pullman but a bold-faced plagiarism, after all? And George M. never owns to it that he has copied the old packets. True, his cars are elegant and sumptuous, and roll along faster than the serene packets; but you can't go on deck to sit on the trunks, sing in the moonlight, or duck your heads at the cry of 'Low bridge!' Nor can you have some youthful, incipient President driving your locomotive, as you might have had driving the team on the towpath. Nor can you enjoy, and study, and analyze the scenery from car windows, at forty miles an hour, as you could from the quietly gliding packets. And then our rival packet lines, the 'Pioneer' and 'Good Intent'—what ardent emulation, with three horses to each boat, tandem on the towpath! Noble ambition to excel!"

Horace Greeley gave a less agreeable picture of

TRAVEL ON THE ERIE CANAL.

In his Recollections of a Busy Life, he says: "I was kindly allowed to visit my father's family in their new western home twice during my apprenticeship, having a furlough of a month in either instance. I made either journey by way of the Erie Canal, on those line boats whose 'cent and a half a mile, mile and a half an hour,' so many yet remember. Railroads, as yet, were not. The days passed slowly yet smoothly on those gliding arks, being enlivened by various sedentary games; but the nights were tedious beyond any sleeping-car experience. At daybreak you were routed out of your shabby, shelf-like berth, and driven on deck to swallow fog, while the cabin was cleared of its beds, and made ready for breakfast. I say nothing as to 'the good old times,' but if any one would recall the good old line boats, I object. And the wretched little tubs that then did duty for steamboats on lake Erie were scarcely less conducive to the increase and diffusion of human misery. I have suffered in them to the extent of human endurance. I have left one at Dunkirk, and walked twenty miles to Westfield, instead of keeping on by boat at a trifling charge, simply because flesh and blood could bear the torture no longer. I trust I have due respect for the 'good old ways' we often hear of, yet I feel that this earthly life has been practically lengthened and sweetened by the invention and construction of railways."

Thomas L. Kenny, in 1826, in his tour to the lakes, while making a trip over the Erie Canal in a cabin boat, wrote as follows:—

"It is not possible for me to convey any adequate idea of the wealth which flows upon the canal; nor of the advantages which are experienced from it by the people who live upon its borders, and those more remote settlements throughout the entire region of the north-west. The truth is, the canal is in everybody's mouth. The yeomanry, the bone and muscle of these regions, make you see in their countenances that they esteem it to be little short of a gift of the gods. . . . The fact is the canal is nothing more nor less than a great sluice of wealth; and the hardy settlers in all these regions are getting rich by the facilities that it affords them."

Of the canal boat in which he made the journey, which was called the DeWitt Clinton, he says: "This boat is considered the best on the line; but her outside appearance, which is, however, like the rest of the packet boats, I confess, made on me, as I came on board, a most unfavorable impression. You have only to go to the Potomac and look at one of your flour boats, of some 70 or 80 feet long, and fancy a box placed upon it, bottom upwards, with its edges on the gunwales, narrowing gradually to the top, and covering the whole length, except some five feet at the bow, where there is a little platform, or deck, and from which, and at the end of this box, is the entrance into the ladies cabin; and some ten feet at the stern, where there is another platform, upon which the steersman stands, and in which end of the cover, or box, are the doors that lead to the gentleman's cabin, and where both gentlemen and ladies assemble to eat, and you have a fair specimen of the exterior of a canal boat." He explains subsequently, that the boat is drawn by three horses, at the rate of speed, generally, of four miles an hour.

UTILITY OF THE CANALS.

NOTWITHSTANDING the final failure of a large proportion of the canals constructed in the United States, in a financial sense, some of them have continued to be useful up to the present day. A few were temporarily great successes, and in the aggregate they rendered immense service to the country, not merely by furnishing avenues for transportation, but by establishing a foundation for the great enterprises by which they have been succeeded and supplanted. They helped to educate civil engineers. They familiarized tax-payers and investors with large expenditures for internal improvements. They gave a great stimulus to traffic by inspiring many producers with the hope of finding a market for the surplus yield of their fields, forests, factories, and mines. They established a powerful connecting link between the Eastern, Middle, and Western states, and hastened the development of the Upper Mississippi valley. In a number of the older sections they furnished the first cheap channels of communication between important local points, and in promoting coal-mining operations they laid the groundwork for one of the most vital elements of American progress. If they had only demonstrated the feasibility of moving large quantities of anthracite and bituminous coal to the seaboard cities, and of transporting a large percentage of the surplus breadstuffs and provisions of the west and north-west to the Atlantic seaboard, they would have yielded to the nation a rich return for their entire cost, and they succeeded wonderfully in performing those great tasks. In their infancy they fostered very sanguine expectations.

THE CHAIN OF NATURAL WATER CHANNELS

is so extensive, and so much was accomplished in the way of creating great through routes, that nearly everything desirable seemed to be a possible result of the skillful grouping of canal, river, lake, gulf, and oceanic navigation. The frequent discussion of schemes intended to revive some of the most ambitious of the early projects shows what a deep impression they made upon the public, but these proposed revivals, in nearly every instance, contemplate the expenditure of large amounts of public money, and rarely or never aim at organizing companies which would assume risks and provide the necessary funds.

In endeavors to form a just estimate of the canal era it should be remembered that it was contemporaneous with the rapid development of steamboat navigation, and in advance of the demonstrated success of railways as advantageous avenues for lengthy transportation movements. The possibilities of complete connections between the internal water systems of this country, and through them with all other portions of the outer world, are bewildering. What was actually accomplished in linking the lakes with the Hudson exceeded all rational expectations, and if plans for connecting Philadelphia, Baltimore, and Georgetown with the Ohio river, had been equally successful, the utility of canals would have been greatly increased and railway progress might have been greatly retarded.

The following statements of

EARLY OPERATIONS ON SOME OF THE CANALS

help to indicate the nature of the hopes they awakened, or the amount and character of the business they transacted:—

An account was published in 1830 of a boat being cleared at the canal collector's office in Albany for Syracuse. It was the yawl boat Scio, in which the captain had left Philadelphia with his wife, children, and furniture, and moved from Philadelphia up the Delaware, through the creek, into the Raritan river, and across to New York, from which city he had moved up the Hudson river to Albany, where he took the canal with the intention of moving up to Syracuse on the Erie Canal and thence up the Oswego Canal to lake Ontario in Jefferson county.

A newspaper published in Milton, Pennsylvania, in July, 1830, says: "The Miltonian—canal boat, Captain James Blair, returned from her trip on Tuesday last, after an absence of six weeks. She left here in May with 1,000 bushels of wheat for Philadelphia, delivered her cargo in prime order; took in a load of oats for Pottsville; loaded at that place with coal for Philadelphia; and has now safely returned to our shore from the latter place, with 20 tons, Nova Scotia plaster. She has had a prosperous trip."

The facility afforded by the Ohio canals for reaching lake Erie and thence forwarding merchandise via Buffalo and the Erie Canal was one of the causes which frustrated the movement of western produce to Philadelphia, even after the main line of public works was completed. It was stated in 1830 that "so great is the facility of transportation from the interior of Ohio to the state of New York, that wheat now commands a higher price at Massilon, one hundred miles west of Pittsburgh, than at the salt works, fifty or sixty miles east of it."

Of the Delaware and Raritan Canal, the Trenton Gazette, in September, 1834, said: "The depth of water appears to be sufficient to pass coasting vessels from the Delaware to the Raritan. The New York papers mention the arrival of the schooner Sarah Ann, loaded with dry goods, in forty-eight hours from Philadelphia, via Delaware and Raritan Canal. The business on the canal appears to be rapidly increasing, and the novel spectacle of masted vessels gliding through the cornfields and woods is presented to our view."

In 1833 hopes of the completion of the Chesapeake and Ohio Canal, throughout its entire length from Georgetown to Pittsburgh, were still cherished, and another project, frequently discussed, for which national aid was solicited, was the construction of a national steamboat canal, which would convert the Susquehanna into an avenue leading directly to the great lakes.

On the Chesapeake and Delaware Canal during the year ended June 1st, 1831, passages were made by 1,232 packets, containing merchandise; 600 vessels, which carried 13,332 cords of wood; 272 vessels with rafts and arks, carrying 7,118,734 feet of lumber; 292 vessels, carrying 101,462 barrels of flour; 246 vessels, carrying 289,173 bushels of wheat and corn, and 2,638 vessels loaded with cotton, iron, oysters, fish, and whisky.

On the Union Canal, of Pennsylvania, the number of tons transported during the year ended November 1st, 1831, was 59,970. The leading articles were 74,905 barrels of flour, 257,565 bushels of wheat and rye, 12,763 barrels of whisky, 5,110 tons of iron, 85,053 bushels of bituminous coal, 13,303,000 feet of lumber (assumed to weigh about one ton per 1,000 feet), 6,292,000 shingles (assumed to weigh half a ton per 1,000), 6,996 tons of gypsum, and 61,920 bushels of salt.

EARLY MOVEMENTS ON THE ERIE CANAL.

In the testimony of Mr. Churchill, before the Senate committee on transportation to the seaboard in 1873, he said:—

"When the Erie Canal was first constructed the freight that moved upon its waters was almost exclusively the product of the state of New York. In 1837, twelve years after western production had felt the stimulus of the Erie Canal, the amount of produce coming into existence outside the borders of New York which reached Albany by the Erie and Oswego Canal was only one-sixth of the whole volume so reaching it; that is to say, of the stuff which reached Albany by the Oswego and Erie Canal at that time, five-sixths of it was the product of New York, and only one-sixth of it the product of foreign territory. . . . Last year (1872) so far was this changed, that only one-twelfth of the freight which reached Albany by the Oswego and Erie Canal was the product of the state of New York, and eleven-twelfths of it was the product of other states."

In the testimony of George S. Hazard he said the Erie Canal had "reduced the transportation of a barrel of flour or a ton of merchandise, between Albany and Buffalo, from $70 to $7 a ton. It has been constantly reducing the price of transportation ever since it was created."

The following are the articles that reached Albany, by the canal, in 1830: In barrels—flour, 396,900; ashes, 25,670; provisions, 22,008; salt, 42,601; whisky, 28,307. Hogsheads of whisky, 1,420; boxes of glass, 6,374; barrels of lime, 2,404. Bushels—of wheat, 209,011; corn, rye, and oats, 114,989; barley, 182,783; cords of wood, 12,976; feet of timber, 31,621; shingles, 11,810,000; feet of lumber, 25,832,142.

The following is a statement of the trade on the

DELAWARE AND RARITAN CANAL

for the month of May, 1848, showing the articles carried through, the rate of freight on the articles, the total amount of freight paid, and the value of the articles:—

Articles carried through.	Quantity. Tons.	Av'ge rate of freight. Rate.	Total freight.	Total value.
Coal	67,478	$1 12½	$75,912	$269,912
Grain and feed, 27,350 bush.	615	4	992	13,675
Lime, 44,229 bushels	1,490	4	1,769	7,076
Salt, 1,550 bushels	52	4	61	310
Timber and lumber, 1,525,957 feet	3,178	1 00	1,525	15,728
Pig and railroad iron	1,675	1 50	2,512	76,375
Flour and corn meal, 4,833 barrels	440	18¾	906	21,748
Whisky, 531 barrels	66	25	133	4,248
Fish, 97 barrels	14	25	24	776
Nails, 1,805 kegs	90	7	125	8,122
Hay and straw	368	1 00	368	3,680
Ice	803	1 25	1,004	4,015
Stone	668	1 12½	751	1,002
Sand	365	1 12½	405	547
Clay	375	1 12½	417	1,125
Brick, 72,770	145	1 12½	82	873
Merchandise	6,666	2 27	13,998	1,513,182
By canal, tons	84,448		$100,984	$1,942,394

RELATIVE MAGNITUDE OF THE AMERICAN CANAL SYSTEM.

In an address delivered by Hon. Levi Woodbury, in Washington, in 1845, he said:—

"The extensive use of science in canaling in this country is another illustration of the great progress in the encouragement of it for practical objects. It is not merely the introduction of locks instead of cranes and inclined planes, which has changed the whole aspect of canals in modern times, from what it was in antiquity, or is now in China, though so long celebrated for its artificial aids to internal commerce. But, beside the great number here, what in length and grandeur, and difficulty, are eighty miles of Egyptian canal across the isthmus of Suez, or a few furlongs more of it, a century or two ago, through the swamps of Holland, compared with those uniting the Ohio with our inland seas, and the three or four hundred miles that wed the waters of our Atlantic with those of lake Erie!"

CAUSES OF CANAL FAILURES.

As corporate enterprises, except in a few specially favored localities, canals were peculiarly unfortunate. In addition to all other troubles, unusual freshets almost entirely destroyed, on several occasions, some of the most expensive works, such as the Lehigh and the Schuylkill canals. The inability to operate them during winter months was a constant source of embarrassment, and one of the most important causes of their failure. The report of the New York Canal Engineer for 1882 forcibly says:—

"It should also be considered that canals can be navigated only about seven months in the year; that the time of their opening and closing is always very uncertain; that their navigation is constantly subjected to detentions, occasioned by the want of an adequate supply of water, together with breakages and other unavoidable accidents, and that the time required for boats to pass between the lakes and tide-water is about five times that required upon the railroads; while, on the other hand, freight may be shipped by railroad every day in the year, and delivered at its destination with the utmost regularity, and at prices generally but very little if any greater, and in many cases much less, than those charged upon the canals.

"The single item of detentions caused by breaks in the canals would of itself, if generally understood, seem to afford sufficient reason for the diversion of a considerable amount of tonnage from the canals, to say nothing of the enormous expense which they entail upon the state.

"It is a matter of surprise that no regular record or account of these casualties has been kept in any department of the state canals, but a careful examination of the different reports shows that from 1858 to 1882, inclusive, embracing a period of twenty-five years, the detentions from breaks in all the canals of the state, so far as any record can be found, amount to 925 days, and that their cost to the state has amounted to $2,042,183, and there can be no doubt that a large percentage may be added to these figures with perfect safety."

A number of the canals, and especially those constructed by states, were located in districts which obviously could not furnish remunerative business. The differences in this respect, in canals, are scarcely less marked than in other transportation enterprises, but there was a much larger percentage of absolute failures, and a smaller percentage of decided successes, in canals than in any other important class of American works designed to promote the movement of freight and passengers.

LOSSES ON THE ABANDONED CANALS.

The canals abandoned in 1880 had an aggregate length of 1,953.56 miles, and had cost $44,013,166. The most important of these works were the following: James River and Kanawha, located in Virginia, 196.50 miles, which had cost $6,139,280; canals in Pennsylvania, which had an aggregate length of 477 miles, and had cost $12,745,780; canals in New York, 356.66 miles in length, which had cost $10,235,314; Ohio canals, 205 miles in length, which had cost $3,217,552, and Indiana canals, 453 miles in length, which had cost $7,725,262.

Only a portion of the pecuniary losses incurred by the construction and operation of canals is represented by the cost of the works which have been abandoned, inasmuch as a number of them were operated for a considerable period during which they failed to earn interest on the cost of construction and repairs. The following are the financial results of the operation of the most unprofitable portions of the canals constructed by the state of Pennsylvania, during most or all of the period from 1830 to 1858, while they remained under state management: The Juniata division, 127 miles, which cost $3,575,966, yielded $1,661,248, and incurred expenses, including cost of repairs, amounting to $2,305,380. The Susquehanna division, 41 miles in length, which cost $897,160, yielded a revenue of $724,092, and incurred expenses amounting to $806,640. The West Branch division, 76 miles long, which cost $1,833,183, yielded $892,995 of revenue, and the expenses were $1,043,695. The Beaver division, 30 miles long, which cost $519,364 (and was operated from 1835 to 1845), yielded $38,312 of revenue, and the expenses were $210,360. The French Creek division, 49 miles long, which cost $817,779, operated from 1833 to 1845, yielded a revenue of $5,821, and the expenses were $143,911. Some of the abandoned New York state canals made a similar financial record, and the Ohio canals also failed, during the later years of their operation, to yield a sum equal to the current expenses. Since the abolition of tolls on the New York canals they, of course, necessarily fail either to earn any interest upon their cost, or to furnish means for repairs and cost of operation. Some of the works of private corporations, or of companies whose capital was represented partly by the subscriptions of individuals, and partly by the subscriptions or donations of states or the United States, have not fared much better. The Chesapeake and Ohio has an exceptionally disastrous financial record.

SUCCESSFUL CANALS.

There were, however, a few notable successes, and the Erie Canal, and some of the canals constructed by the state of Pennsylvania, during the period when they were operated for the purpose of deriving as large a revenue as could conveniently be obtained, made fair returns. The Eastern division of the Pennsylvania Canal, 46 miles in length, which cost

$1,737,285, yielded, during the period from 1830 to 1857, a revenue of $3,405,632, and the expenses were $1,071,595. The Delaware division, 60 miles in length, which cost $1,543,763, yielded a revenue of $4,123,377, and the expenses were $1,572,550. The Erie and Champlain canals of New York, up to September 30th, 1882, had yielded revenues amounting to $127,878,212.46; the cost of collection, superintendence, and ordinary repairs had been $34,900,324.55; and the apparent profit in operating was $92,977,887.91. This sum, however, made no allowance for interest on canal loans, or other means of providing for the cost of construction, which was $54,505,148.47.

On all the canals operated by states and corporations in the United States in 1880 the quantity of freight transported was 21,044,292 tons. The length, dimensions, and freight traffic of those over which more than a million tons were transported were as follows:—

	Length. Canal miles.	Length. Slack-water miles.	Width. Surface feet.	Width. Bottom feet.	Depth.	Freight traffic. Tons.
Erie, branches, and feeders	365.48	29.59	70	52½	7	4,608,651
Champlain, feeders, and dams	81.00	....	58	44	6	1,200,503
Delaware and Hudson	83.00	3.00	48	32	6	1,329,313
Delaware and Raritan	44.00	....	80	..	7	1,348,082
Monongahela Navigation	....	....	..	..	5½	3,450,400
Saint Mary's Falls (ship)	100.00	....	..	..	17	1,244,279

In addition to the above the tonnage of the most important canals operated in 1880 was as follows: Pennsylvania Canal Company's canals, 861,798 tons; Schuylkill Navigation, 630,416 tons; Lehigh Coal and Navigation and Delaware division, 719,338; Chesapeake and Delaware (ship), 959,146 tons; Chesapeake and Ohio, 655,423 tons; Albemarle and Chesapeake, 400,000 tons; Illinois and Michigan (ship), 751,360 tons; Ohio Canal and feeders, 429,626 tons; Miami and Erie Canal and feeders, 323,737 tons.

PENNSYLVANIA STATE CANALS.

As compared with the Pennsylvania main line of canals and railroads the Erie Canal was much the most successful of the two undertakings, for various reasons. Connection with the lakes proved more advantageous than connection with the rivers uniting at Pittsburgh, and the fact that the use of inclined planes was necessary on the Pennsylvania canals, at the Portage Railroad, proved a very serious obstacle to cheap movements. Inclined planes represent the old Chinese method of operating canals, and they have been adopted by a few American and European lines, one instance being furnished by the Morris Canal and another by the hauling of boats over the Portage Railroad, but after locks were invented in Italy, a short time before the discovery of America, their superiority as a device for overcoming elevations was almost universally acknowledged, and inclined planes were rarely used, except over routes which required that an unusually high or great elevation should be overcome. In constructing the Erie Canal the rise and fall along the entire line was only 692 feet. It was largely on account of the remarkably deep or favorable depression in the mountain chain or elevated plateau that divides the waters flowing directly into the Atlantic from those emptying into the Mississippi, which was found along its route, that the Erie Canal achieved its noted success in an enterprise which, in some of its important bearings, encountered ill-fated rivalry, from the Chesapeake and Ohio Canal as projected, and the Pennsylvania main line, as completed. In adopting, on the Pennsylvania main line system, the Portage Railroad as a device for overcoming the elevation of the Allegheny mountains, there was an ascent from Johnstown, west of the mountains, to the summit, of 1,171.58 feet in 26.59 miles, and on the eastern side of the mountains a descent from the summit to Hollidaysburg, of 1,398.71 feet in 10.10 miles. In other words, the Pennsylvania main line system, by the aid of the Portage Railroad, undertook to overcome, in a distance of 36.69 miles, about twice the elevation that it was necessary to overcome, by locks, along the entire length of the Erie Canal. The result was the completion of a work which was regarded, at the time, as the most magnificent engineering work in America, but which, in its practical operations, was exceptionally unfortunate. The Portage Railroad, 41 miles in length, cost $2,708,672. It was operated by the state from the latter part of 1834 to July 31st, 1857, and during that period it yielded a revenue of $3,648,611, and its expenses were $4,876,334. Soon after it was sold by the commonwealth it was abandoned, and the state canal west of the mountains, with which it was connected, was also abandoned. Of its practical operations, Mr. Solomon W. Roberts, an engineer who helped to construct it, says: "One thing that was considered to be a great curiosity, was the carriage of canal boats over the mountain, which was done to a considerable extent. The road being, as its name implied, a Portage Railroad, a transhipment of some sort was required at both ends of the line, which caused expense and delay. Different firms, engaged in the transportation business, tried different plans to diminish the evil. One plan was the use of boats built in sections, and carried in trucks over the railroad. Another mode of carrying freight, was in cars having movable bodies, which could be lifted off the wheels, and transferred to canal boats fitted to receive them. The wear and tear of the sectional boats, and movable car bodies, and the amount of dead weight that had to be carried, were found to be serious objections to both these plans." The Portage Railroad cannot be regarded, in an engineering sense, as a mere inclined plane attachment or adjunct, of a line of canals. In some respects it was much more. But it served the purpose indicated, and furnished an important additional illustration of the inherent difficulties and expenditures which attend efforts to use, on an extensive scale, the same vehicles or vessels, in a combined land and water route.

Another obstacle to the success of the Pennsylvania state canals was their inferior size, as compared with the New York canals. All the former were uniform in dimensions, viz.: 28 feet wide at bottom, 40 feet at water line, and 4 feet deep, with the exception of the Delaware division which had a depth of 5 feet. The dimensions of the prism, on the enlarged New York canals, were originally intended to be as follows: Width of water at surface, 70 feet; width of bottom, 56 feet; depth of water, 7 feet. Although these dimensions were modified in many cases in the widths at surface and bottom, to meet the character of material comprising the slopes, steady efforts were made to avoid a diminution of the cross-sectional area of waterway.

In all modern transportation movements the size of the vessel or vehicle used in transporting freight is one of the most important elements of economy. For this reason, if for no other, small canals cease to be remunerative, while improvements designed to increase the capacity of important natural waterways, or to construct ship canals over routes of great consequence render very essential service.

CANAL OPERATION FROM A MULE DRIVERS' STANDPOINT.

Notwithstanding the use of steam power, to a limited extent, on a few of the canals, on the New York canals, in 1882, only 92 of 4,000 boats then in use were propelled by steam. A driver of the mules attached to one of the boats was interviewed in 1883 with the following result:—

"Well," began the reporter, "how are the boys along the towpath getting along this season?"

"Oh, this season's a good 'un," readily answered the muleteer; "it's never nothin' to brag about."

"How do the drivers work?" further queried the scribe; "by the trip or by the day?"

"Both ways. A man can git a dollar a day, or he can hire out by the trip, and git about twenty dollars a month. But when he works by the day he gits nothin' when a boat unloads, and working by the trip his pay goes right on. So it makes it even."

"How long does it take to make a trip from Buffalo to Albany and return?"

"Depends on the load. About three weeks on an average. The current goes east, so it's easier goin' to Albany than comin' back."

"How many trips can a boat make in a season?"

"About nine or ten."

"This boat you are driving is loaded with wheat. How many bushels does it hold?"

"About 8,000."

"Is the rate of payment larger this year than last?"

"Oh, yes. They git six cents a bushel this year, and only three and a half last, and no tolls to pay neither. Bizness is mighty good this season."

"How are your hours of duty divided?"

"Wal, there allers is two drivers. Each un has six hours day and six hours night driving. His mules change when he does."

"Is pulling a canal boat very hard work for the mules?"

"A mule kin stand it better'n a hoss. Take a hoss and it only takes a few seasons to wear him out. Now you mayn't believe it, but that off mule has been pulling a boat twenty-three years."

"But isn't a mule harder to drive?"

"Wal, yes; they git kinder rambunctious sometimes. Whoa, there!" he suddenly shouted to his mule, who was attempting to execute a fandango upon the towpath. After the brute became quieted, he proceeded: "Something cur'us about them mules. You can ca'c'late their age pretty close every time by the way they wobble their ears. Take a young mule, and he twists 'em all shapes all the time; when he gits old he quiets down and holds 'em kinder steady. They're mighty good for telling the weather, too; when a mule keeps his ears pricked up it's a sure sign of rain."

"Driving nights is pretty lonesome work, isn't it?"

"Now yer shouting. All alone in the dark, and no one to talk to 'cept a mule, it's mighty lonesome. Then when it rains an' is stormy it's not much fun peggin' along an' hollerin' at your mule."

"How many months of a year does a driver work?"

"Oh, eight or nine months is fair. Sometimes nine or ten, though, when the weather is good."

"And what do you do winters?"

"Haul up at either end, and git what you can. Sometimes you can get work on the railroad and sometimes nothin' at all."

"How many men are there on a boat?"

"Five gen'rally. There's two drivers, two steersmen, and the cap'n."

"The steersmen, of course, get higher wages than the driver?"

"Oh, yes; a steersman can get about $40 a month. That's the place the driver is allers fishin' fur. It takes about four or five years driving to get there, though."

Then the mule began to elevate his heels in a manner that rendered a position in the rear extremely precarious, and the reporter sought a safer ground than on the towpath within two feet of the kicking apparatus which makes every well-organized mule respected.

IMPROVEMENT OF VEHICLES USED ON ROADS.

THERE are three great elements of advancement in transportation systems, viz.: 1, improvement of the roadway; 2, improvement of the vehicles used; 3, improvement of the motive power by which the vehicles are propelled. To a considerable extent progress made in each of these improvements is interdependent. The extensive use of the best forms and varieties of wheeled vehicles cannot be expected in a country destitute of good roads, and the vigorous exercise of inventive talent in improving vehicles only commenced at a comparatively late period. On the other hand, there must be a number of vehicles extant, and an earnest desire to use them, before the movements which finally lead to the construction of good roads are energetically prosecuted. Genuine and important advancement usually proceeds in parallel lines. While the roads are being improved in a marked degree, the vehicles are also gaining in utility, convenience, strength, lightness, and adaptability to their intended uses. When motive power is represented by the horse, the qualities of that animal are changed, as far as possible, by breeding and training, to accord with the new requirements arising from improvements in roads and vehicles; and when motive power is represented by locomotives, their size, speed, and capacity varies with the demands of the public and the characteristics of the permanent ways they are to traverse.

Wheeled vehicles are of great antiquity, and after the Romans constructed superior roads in the vicinity of their capital, improvements of considerable significance were made in the carriages of that early era. But further progress was arrested, partly by the abandonment of the Roman method of making and maintaining roads, and partly by peculiarities of the feudal system, which required superior horsemanship and discouraged or partly prohibited the use of vehicles by men, for personal movements. The sentiment prevailed for centuries that it was a sign of effeminacy for a man to ride in a carriage, and the extirpation of this feeling is a comparatively modern achievement.

The American colonists naturally brought with them to this country and maintained here views similar to those which prevailed in their native lands, but before the nineteenth century progress in nearly all industrial directions, and especially in matters relating to roads and vehicles, was more rapid in the old world than on the western shore of the Atlantic, on account of the relative abundance of capital, and engineering and inventive talent in England and on the continent. Irrespective of subdivisions which now exist, the numerous modern wheeled vehicles are of two classes, one being generally used principally for the movement of passengers and the other for the movement of freight. The former may be designated as coaches or carriages, and the latter as

CARTS OR WAGONS.

In colonial development carts were the wheeled vehicles first used to a considerable extent, and they were gradually supplemented by wagons. Carriages corresponding to those contemporaneously used in England were also introduced, but they were owned by only a very small number of the resident population and formed the luxuries of the few rather than a common possession. To facilitate farm freight movements carts (and sleds in northern latitudes) were almost indispensable, and in a few of the colonies a considerable number of wagons were used at a comparatively early period. But the number of wagons and carriages in most of the colonies was very limited before the close of the Revolutionary War, and Bishop's History of American Manufactures says that in 1750 only the best farmers of many sections had carts on their farms. There were districts in which sleds were used in summer as well as in winter, and of the early carts and wagons it is stated that their construction was at first very rude, as little or no iron was used, and the wheels were generally of solid wood, cut with a saw from the end of a log. These primitive contrivances were but little if any better than the rude Mexican vehicles described recently in the following extract from the Chihuahua Enterprise: "Frequently on the streets of Chihuahua can be seen carts, so primitive in their construction and so rude in their proportions, that they at once become objects of wonder and astonishment to those who have never seen them before. The wheels of these carts are solid, or made of solid pieces of timber pinned together, and, with few exceptions, are about as near round as blocks with their corners cut off and slightly rounded, and what may seem strange, there is no iron or any other metal used in their construction. Rawhide and wood alone are used, and these materials are so combined that the cart is made, but so ill-shaped and proportioned that it might easily be taken for the one Jacob took down with him into Egypt for corn. The spindles extend six or eight inches outside of the wheels, and a wooden linch-pin holds them in place. These spindles are soon worn, and the consequence is the wheels 'wobble' from side to side, and as no grease is used, a screeching noise generally announces their approach. The tongue is a long pole fastened to the axle-tree with rawhide, and at the other end are fastened the poor oxen with yokes lashed behind their horns with band of the same material. The wheels are generally from three to four feet in diameter, but sometimes they are seen much larger, perhaps five to six feet. It is probably not generally known, but we are informed it is true, that the oxen lashed to the tongue, in one to two years, have all their teeth shattered out. Any one noticing these carts passing over the cobble stones in the streets and seeing in what an unmerciful manner their heads are jerked from side to side and up and down, would not be slow to believe the statement. These carts often come in heavily loaded, with from two to four yokes of cattle hitched to them, and the driver, with a long pole in his hands, running from one side to the other, punching them with the spike end of his pole. It is a novel sight, but one that excites pity and commiseration in the hearts of those who look on for the first time. But these will soon disappear and a new state of things will be inaugurated."

RELATIVE ABUNDANCE OF WAGONS IN PENNSYLVANIA.

Indications that Pennsylvania was more abundantly supplied with wagons than adjacent colonies are furnished by the fact that 150 wagons were readily obtained in that state, for the use of Braddock's expedition, in 1755, through the exertions of Dr. Franklin, after the failure of similar efforts in Maryland and Virginia, and by the following extract from a protest addressed by president Reed, of Pennsylvania, to General Washington, in a letter dated August 3d, 1780:—

"We are informed that a further demand of teams to the amount of 1,066 is to be made on this state. We should be wanting in duty to the public as well as justice to your Excellency not to take the first opportunity to inform you that we do not think it practicable to comply with it. The letters we receive from the wagon masters assure us of the greatest difficulties in performing former orders. The number of teams in the state is greatly reduced. Lancaster county, which formerly registered 1,700, now does not register 500, and many of those are ordinary. Some of the other counties have declined in a greater proportion. We must intreat your Excellency to believe it is with real reluctance we decline any requisition, because we are persuaded you would not make any which you did not deem necessary, but we dare not mislead in points of so great consequence to give expectations where we have no solid ground to go upon. The present resources and ability of this state are greatly exaggerated, whether through ignorance or design is not so material. The prices given in specie are the most undeniable proofs of it. The horses purchased by the French commissary, tho' not of the first quality, have, on an average, cost £60 each. His waggons are engaged on a like scale. The justice of our remarks must appear more clearly when your Excellency recollects that *the army has been chiefly supplied with horses and waggons from this state during the war, that the most of them now attached to the army are drawn from this state. The quartermaster yesterday declared that half of all the supplies furnished the army (imported articles excepted), had been drawn from this state for three years past.*"

CONESTOGA TEAMS AND WAGONS.

The primitive condition of carts and wagons could scarcely have remained unimproved during a very protracted period in any of the numerous communities in which a blacksmith and a wheelwright were established and busily engaged in prosecuting their labors. As compared with the other colonies the early industrial development of Pennsylvania necessitated extra efforts to utilize wheeled vehicles, on account of the absence of tidewater, except along a small portion of her south-eastern boundary, and the great extent to which interior regions were traversed by mountainous systems. The presence of a large German population in interior localities where they would have been shut off from access to markets for surplus produce if roads had not been constructed and carts or wagons used, also gave an impetus to progress which had as one of its results the invention or construction of the Conestoga wagon. It was regarded for a considerable period as the highest type of a commodious freight vehicle in the country, especially for traversing hilly or mountainous roads, and was first used about 1760. One of its peculiarities was a decided curve in the bottom, analogous to that of a canoe, the object of which was to prevent freight from slipping too far to the front when wagons were going down hill, or too far to the rear when they were going up hill. By this device a gain in effective power in movements over the mountains was attained. The Conestoga wagon received that title either because the four, five, or six horses by which it was drawn were usually of the breed of heavy draft horses that had been developed in the Conestoga valley of Lancaster county, Pennsylvania, or because the wagon itself was first constructed there, or because the teams came most frequently from that locality. Although the use of Conestoga wagons gradually extended to a number of sections, the farmers of the Conestoga valley owned an exceptionally large number of them during their period of special usefulness, which was that preceding the construction of canals and railways over important interior routes of trade. Hon. John Strohm, in an article on the Conestoga horse, contributed to the United States Agricultural Report for 1863, says that "the immigration to and settling of the western states created a demand for the transportation of large quantities of dry goods and groceries to supply the wants of those engaged in opening up and settling these new countries; and many farmers in the Conestoga valley occasionally employed their teams in hauling 'store goods' from Philadelphia to Pittsburgh, the latter place being the terminus beyond which eastern teams seldom went. During the war of 1812 these noble teams rendered essential service to the country in the transportation of arms and ammunition, and supplies to the army on the frontier. Long lines of these teams were frequently seen wending their weary way to the theatre of action, and contributing greatly to the comfort of the army and the defence of the country. Their usual route of travel was from Philadelphia through Lancaster, crossing the Susquehanna at Columbia or Marietta, and thence over the mountains to Pittsburgh, and sometimes northward to lake Erie. The capacious wagons which the Conestoga farmers then had in use, and the heavy teams of large, fat, sleek horses attached thereto, were the best means of land transportation which the times and circumstances of the country then afforded. These wagons and teams attracted attention and commanded admiration wherever they appeared; and hence the origin, as I conceive, of the horse and wagon to which the appellation of 'Conestoga' has been attached. The farmers of those days seemed fully to appreciate the importance of these teams, and evinced considerable taste and no little pride in their style of fitting them out. The harness was constructed of the best materials, with an eye to show as well as utility. In the harness and trimmings of these teams they frequently indulged in expenses that approached to extravagance. In addition to what was indispensably necessary, articles that by some were deemed decorations were sometimes appended, and served to increase the admiration which the noble animals to which they were attached so universally attracted. It was, indeed, an animating sight to see five or six highly-fed horses, half covered with heavy bear skins, or decorated with gaudily-fringed housings, surmounted with a set of finely-toned bells, their bridles adorned with loops of red trimming, and moving over the ground with a brisk elastic step, snorting disdainfully at surrounding objects, as if half conscious of their superior appearance, and participating in the pride that swelled the bosom of their master and driver."

WAGON MOVEMENTS ON THE PLAINS.

In western emigration movements, first to the states east of the Mississippi, and subsequently to new states and territories west of the Missouri, wagons were very extensively used before the construction of railroads. The plains furnished a great theatre for their use from the time of the discovery of gold in California up to the period of the construction of the first Pacific railroad. In addition to the wagons used by emigrants, the wagon-freighting business became quite extensive, as large quantities of supplies for forts and new settlements and mining machinery were forwarded. It is stated that in 1865, when Atchison, Kansas, was the principal point on the Missouri river (but by no means the only one) from which freight was forwarded to Colorado, Utah, Montana, and other new territories, there were loaded in that city 4,480 wagons, drawn by 7,310 mules and 29,720 oxen. To control and drive these teams 5,610 men were employed, and the reported amount of freight carried was 27,000 tons. In the same season the aggregate shipments from Kansas City, Leavenworth, St. Joseph, Omaha, and

Plattsmouth were supposed to be fully equal to or greater than the shipments from Atchison, and, supposing this estimate to be correct, there were employed in the overland freight business in 1865 8,960 wagons, 14,620 mules, 59,440 cattle, and 11,220 men, who moved 54,000 tons of freight. The investment in the teams and wagons used was estimated at $7,289,300.

In some cases mining machinery of great weight was hauled over long distances. An illustration was published of a mule team, consisting of eighteen mules, drawing boilers and machinery weighing 54,000 pounds. The machinery is loaded in four vehicles, each of peculiar construction.

MOVING HOUSES.

In other cases, when some of the town speculations with which the new west teemed proved disastrous, houses were moved to more promising sites. A description of such a movement says: "The people generally had abandoned all hope of the city, and were moving their houses bodily to Devil's lake and other places. The houses were first lifted on to large timbers of sufficient size and strength to bear the weight of the house. These timbers were then suspended under two monstrous freight wagons on either side of the building. Four large horses or oxen were then hitched to the wagons on each side, and the road to Devil's lake being across a smooth prairie, the teams were able to move along easily with a fair-sized building. It was a beautiful afternoon that I rode in a hack over that twenty miles. Very often the team had to move around these houses on wheels. Some of them, with the teams attached, presented to my mind sights most magnificent. It was the first time that I had ever seen a city moving on wheels. I had seen people moving on a large scale in their so-called 'prairie schooners,' but the sight was tame compared with this. I thought of a remark I once heard my friend Crosby make to the effect that he 'thought the approach of a train of cars drawn by a powerful engine was a magnificent sight to behold,' and I thought to myself if he could see a road lined by two-story houses, moving to the music of the steady tread of teams of eight powerful oxen, he would have regarded the sight equally magnificent."

ECONOMIC RELATION BETWEEN CARTS AND WAGONS.

In England during the closing years of the eighteenth century and early portion of the nineteenth, a huge wagon approximating in size to the Conestoga wagon, was in general use in all common carrier overland freight movements, while in Scotland the cart, or one-horse vehicle, in various improved forms, continued to furnish corresponding facilities. One of the reasons assigned for this preference was that more work could be performed by a single horse attached to a cart, than by the same animal if he served in conjunction with one or more horses. The belief was expressed that two horses working separately in two carts, would exert as much useful power as three horses of equal strength who were jointly attached to a single wagon. The cart, like early forms of two-wheeled carriages, such as the chaise or gig, compels the horse to serve in the double capacity of bearing a part of the burden attached as well as pulling it, and thus calling into exercise all his available strength, while wagons and modern carriages utilize his powers only as a draught animal, and it may be that circumstances connected with the condition of roads, the desirability of extracting the largest amount of available service from a single horse, differences in relation between the value of human and horse labor, or other causes, led some communities to prefer and continue the use of carts or one-horse freight vehicles, while others preferred wagons drawn by two, four, five, six, or eight horses. Whatever the cause may have been a difference analogous to that existing between prevailing habits in Scotland and England also existed between various states and districts of this country. The ante-revolutionary history of freight vehicles in the American colonies may probably be summed up in the statement that sleds were used extensively, that after carts became common a number of them were very rudely constructed, that the highest form of freight vehicle developed, before a comparatively recent period, was the Conestoga wagon, and that while some sections preferred and continued to use carts, mainly, others had commenced using wagons.

OF SLEDS

Henry's History of the Lehigh Valley says that about 1783, "farmers from a distance generally awaited good sledding in winter as the most convenient manner of transportation. Very frequently the streets of Easton presented a very busy scene, 500 sleds either standing in the streets or passing through them, and sometimes from 15,000 to 20,000 bushels of grain were received by the merchants in one day." Even at the present time, in the mountainous districts and the lumber regions of Pennsylvania, and various northern states, most of the local hauling is done in the winter.

FREIGHT AND PASSENGER WAGONS—LIGHT VEHICLES.

THERE was a considerable period during which relative scarcity of light vehicles led to the adoption of the custom of using freight wagons for the transportation of passengers to an extent which can hardly be realized now. It was not only in ordinary trips of farmers with wagon-loads of produce to adjacent markets, and in emigration movements, that members of the family or neighbors or friends were carried in wagons partly devoted to freight, but the early common-carrier enterprises combined passenger and freight traffic in the same wagon. In England the custom was well established during the last century of devoting a portion of the large and heavy wagons, used mainly in gathering up freight, to passengers, who were, presumably, generally such persons as would in the present day travel in emigrant or third-class cars. In the emigration movements by which eastern farmers obtained new homes in the western states, and by which western families crossed the plains, the same wagon that carried the household goods generally carried women, young children, and infirm old persons, while the vigorous husband and half-grown boys were expected to make a large portion of the journey on foot. This method was a type of customs prevailing in agricultural districts supplied with wagons, yet comparatively destitute of light vehicles, during a large portion of the first half of the nineteenth century. In the Southern states a wagon was extensively used during the early years of this century which provided unusually complete facilities for the accommodation of passengers by day and night, and such wagons were used in many of the southern emigration movements.

MOVEMENTS BETWEEN PHILADELPHIA AND NEW YORK.

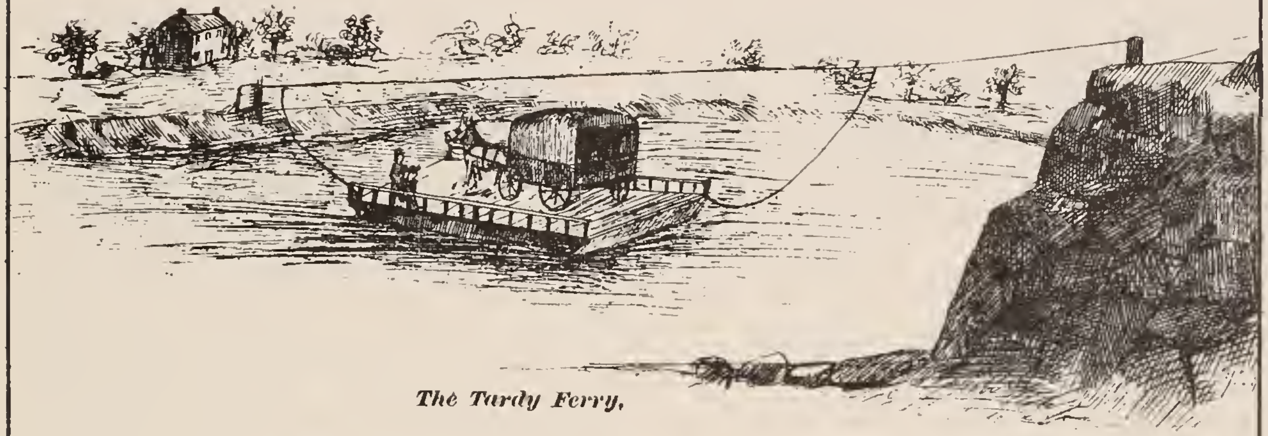
Early common-carrier lines for transporting freight between Philadelphia and New York, through New Jersey, also combined freight and passenger movements in the same wagons.

The following advertisement relating to movements between Burlington and Amboy, appeared in Andrew Bradford's Philadelphia Mercury of March, 1732:—

"This is to give notice unto gentlemen, merchants, tradesmen, travelers, and others, that Solomon Smith and James Moore, of Burlington, keepeth two stage wagons intending to go from Burlington to Amboy, and back from Amboy to Burlington again, once every week or oftener if that business presents. They have also a very good store house, very commodious for the storing of any sort of merchants goods free from any charges, where good care will be taken of all sorts of goods." Of the stage wagons used by this line to carry passengers it is said that they had no springs.

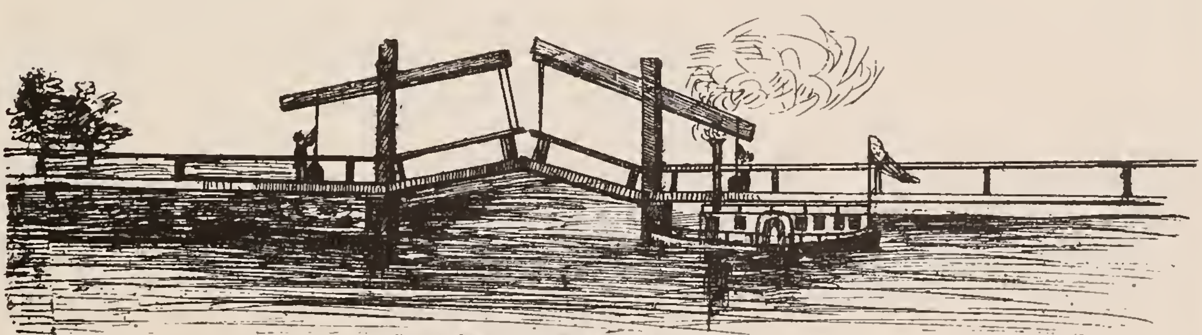
In 1765 another line began to start twice a week, but no increase of speed was claimed. In 1766 a third line was established, the proprietors of which set forth, as one of its attractions, that it had "good stage wagons, *with the seats set on springs*," and that it would go through in two days in summers and three in winter. These wagons were called Flying Machines, and

The Dangerous Ford.



The Tardy Ferry.

Rural Wooden Bridge.



Primitive Drawbridge.

that title came into general use among the rival stage proprietors.

From 1765 to 1768 the New Jersey legislature made an attempt to raise funds by lottery for shortening and improving the great thoroughfares of that colony, but the effort was not successful. Governor Franklin, alluding to the roads in a speech to the assembly, in 1768, said that "even those which lie between the two principal trading cities in North America are seldom passable, without danger or difficulty." The roads were probably improved to some extent during the next few years, as John Mersereau announced a "flying machine" in 1772, which was to leave Paulus Hook three times a week with a reasonable expectation that passengers would arrive in Philadelphia in a day and a half. This, however, was found to be too rapid a pace to be maintained, for he required two days for the journey in 1773–74.

The use of "stage wagons, with the seats set on springs," and "flying machines," probably marked a transition era, when passenger traffic was gaining sufficient importance to require that those who embarked in it should either abandon freight business altogether or make it a subordinate feature.

Of vehicles intended exclusively for the transportation of passengers the number owned by private individuals was very small, as riding on the back of a horse continued to be the usual and favorite method of persons in presumably good circumstances for making journeys in nearly all sections of the country until the nineteenth century was well advanced.

At an early period a line for the carriage of goods and passengers was put on the rival road in New Jersey, leading between Philadelphia and New York, via New Brunswick, and in 1734 Bordentown was made the southern terminus of a line the proprietors of which promised to be in New York, "once a week if wind and weather permit, and come to the old slip." In 1744 stage wagons between New Brunswick and Trenton ran twice a week. In October, 1750, a new line was established, the owner of which resided at Perth Amboy. He informed ladies and gentlemen "who have occasion to transport themselves, goods, wares, or merchandise, from New York to Philadelphia, that he had a stage boat well fitted for the purpose, which, wind and weather permitting, would leave New York every Wednesday for the ferry at Amboy on Thursday, where, on Friday, a stage wagon would be ready to proceed immediately to Bordentown, where they would take another stage boat to Philadelphia." He claimed that passages could be made in forty-eight hours less time than by any other line, but he still kept them from five to seven days on a journey now made in two hours. Another line was started in 1751 which laid special stress upon the superiority of its passage boat between Amboy and New York. It is described as having a fine commodious cabin, fitted up with a tea-table, and sundry other articles. In 1756 a stage line between Philadelphia and New York, via Trenton and Perth Amboy was established which aimed at making the journey in three days. The advertisement of this enterprise, published November 6th, 1756, is as follows:—

"Notice is hereby given that we, the subscribers, John Butler, of Philadelphia, at the sign of the Death of the Fox in Strawberry Alley, begins his stage on the Tuesday, ninth of this instant, November, from his house, and will proceed with his wagon to the house of Nathaniel Parker, at Trenton Ferry; and from thence the goods and passengers to be carried over the ferry to the house kept by George Moschel, where Francis Holman will meet the above John Butler and exchange their passengers, etc., and then proceed on Wednesday through Princetown and New Brunswick to the house of Obadiah Aries in Perth Amboy, where will be a good boat with all conveniences necessary, kept by John Thomson and William Walter, for the reception of passengers, etc., who will proceed on Thursday morning without delay for New York, and there land at Whitehall, where the said Walter and Thomson will give attendance at the house of Abraham Bockeys until the Monday morning following, and then will return to Perth Amboy, where Francis Holman on Tuesday morning following will attend and return with his wagon to Trenton Ferry to meet John Butler, of Philadelphia, and there exchange their passengers, etc., for New York and Philadelphia.

"It is hoped that as these stages are attended with a considerable expense for better accommodating passengers, that they will meet the favor of the public, and whoever will be pleased to favor them with their custom shall be kindly used and have due attendance given them by their humble servants, John Butler, Francis Holman, John Thomson, and William Walter."

SCARCITY OF LIGHT VEHICLES.

Watson's Annals says that "an aged gentleman, who died in the fever of 1793, said he could remember when there were only eighty four-wheeled carriages kept in all the province of Pennsylvania. In Philadelphia there were, in 1761, three coaches, two landaus, 18 chariots and 15 chaises, making a total of 38 vehicles. In 1772 the number had increased to 84, and a list of improved or pleasure carriages in 1794 shows that in that year they were reported to consist of 33 coaches, 137 coachees, 35 chariots, 22 phaetons, 80 light wagons and 520 chaises and sulkies."

In 1796 there were owned in Philadelphia 307 four-wheeled carriages and 553 two-wheeled vehicles. We can scarcely realize now that the use and ownership of a light vehicle for making journeys by farmers was formerly considered as scarcely prudent or proper. The United States Gazette of 1813 winds up a jeremiad about the ruin of the country on account of extravagance by saying that "even the farmers want carriages."

The sensation produced by George Washington, near the close of the eighteenth century, when he traveled through various parts of the United States in a coach, may have been heightened by the fact that he used a coach during an era when few persons possessed them; and the amusing old definition of respectability in England, which made that attribute hinge on the possession of a gig, may have originated in the fact that bad roads, a low state of the mechanic arts, and relative impecuniosity among all classes, combined to make such ownership a significant outward sign of wealth and luxurious habits.

PASSENGER MOVEMENTS ON EARLY TURNPIKES.

The charter of the first important turnpike company granted in the last decade of the eighteenth century provided for tolls on every chariot, coach, stage wagon, or chaise, and the same or similar tolls, sometimes with a few minor additions, are contained in laws relating to ferries of an earlier date. In a law relating to turnpike tolls, passed in Pennsylvania in 1810, charges were authorized on "every sulky, chair, chaise, with one horse and two wheels," and on "every chair, coach, phaeton, chaise, stage wagon, coachee, or light wagon with two horses and four wheels." By a singular change in customs, which occurred some years later, the most important revenue on some of the turnpike companies subjected to similar provisions was finally derived from a class of vehicles not designated in their charters, viz., pleasure carriages of various kinds drawn by one horse and having four wheels. They seem to have been either unknown or exceedingly scarce in this country before the present century, and all vehicles intended for passenger movements presumably belonged to one of two classes; either two-wheeled vehicles drawn by one horse or four-wheeled vehicles drawn by two or more horses. Another subdivision might be based on the number of persons they were intended to accommodate. The two-wheeled and one-horse vehicles were either sulkies in which one person could be conveniently seated, or a two-wheeled chair, chaise, or gig, having a seat wide enough to accommodate two persons. The four-wheeled vehicles, as a rule, always had at least two seats and frequently more.

The efforts of inventive genius have very greatly improved coach, carriage, and wagon building. Every portion of all classes of vehicles has been greatly advanced and many new shapes and forms have been introduced. Independent of a host of substantial additions several great fundamental changes have been made which continue to materially affect the characteristics of nearly all wheeled vehicles. One of the most important of these relates to springs. Before the present century very few steel carriage springs were used in this country, and the modern form of elliptic springs was only invented in the early part of the nineteenth century. Presumably the favorite method of guarding passengers against concussions on rude roads was hanging the bodies of coaches on strong leather supports, and this system continued to be used extensively during a large portion of the present century. Leather straps or supports to promote the comfort of passengers had been used for centuries, and steel springs had been extensively employed as a substitute for them in this country and England for a considerable number of years before

THE USE OF STEEL SPRINGS

on an extensive scale, on vehicles intended mainly for the transportation of freight, became at all general. This last-named change has probably done more than any other single thing to improve freight vehicles. The significance of this improvement can, perhaps, be best described by the following reference to testimony taken before a select committee of the House of Commons on steam carriages, in 1831, which was reprinted by the House of Representatives, at Washington, in 1832. In response to the question, "Have you paid any attention to the general nature and advantages of wheels and springs for carriages, the draughts of cattle and the form of roads?" Davies Gilbert, a member of the committee, made remarks which embrace these extracts:—

"Taking wheels completely in the abstract, they must be considered as answering two different purposes. First, they transfer the friction which would take place between a sliding body and the comparatively rough, uneven surface over which it slides, to the smooth, oiled perphiries of the axis and box, where the absolute quantity of the friction, as opposing resistance, is also diminished by leverage in the proportion of the wheel to that of the axis.

"Secondly, they procure mechanical advantage for overcoming obstacles in proportion to the square roots of their diameters, when the obstacles are relatively small, by increasing the time in that ratio, during which the wheel ascends; and they pass over small, transverse ruts, hollows or pits, with an absolute advantage of not sinking proportionate to their diameters, and with a mechanical one, as before, proportionate to the square roots of their diameters. Consequently, wheels thus considered cannot be too large. In practice, however, they are limited by weight, by expense, and by convenience. . . . *Springs were in all likelihood applied at first to carriages, with no other view than to accommodate travelers.* They have since been found to answer several important ends. They convert all percussion into mere increase of pressure; that is, the collision of two hard bodies is changed, by the interposition of one that is elastic, into a mere accession of weight. Thus the carriage is preserved from injury, and the materials of the road are not broken; and in surmounting obstacles, instead of the whole carriage with its load being lifted over, the springs allow the wheels to raise, while the weights suspended upon them are scarcely moved from the horizontal level. So that, if the whole of the weight would be supported on the springs, and all the other parts supposed to be devoid of inertia, while the springs themselves were very long, and extremely flexible, this consequence would clearly follow, however much it may wear the appearance of a paradox, that such a carriage may be drawn over a road abounding in small obstacles without agitation, and without any material addition being made to the moving power or draft. It seems, therefore, probable that, under certain modifications of form and material, springs may be applied with advantage to the very heaviest wagons. . . . The advantages consequent to the draft, from suspending heavy baggage on the springs, were first generally perceived about forty years since on the introduction of mail coaches. . . . The extensive use of wagons suspended on springs, for conveying heavy articles, introduced within these two or three last years, *will form an epoch in the history of internal land communication not much inferior, perhaps, in importance to that when mail coaches were first adopted;* and the extension of vans, in so short a time, to places the most remote from the metropolis, induces a hope and expectation that, as roads improve, the means of preserving them will improve also, possibly in an equal degree; so that permanence and consequent cheapness in addition to facility of conveyance, will be distinguishing features of the Macadam system."

SPRINGS AND OTHER IMPROVEMENTS.

ALMOST all light and heavy freight wagons now used in American cities are provided with springs, and by their use a great gain is effected in the speed at which wagons can be moved, in the weight that a horse or a given number of horses can draw, and in the diminution of the shock and pressure to which roads and pavements are subjected. A large proportion of the light freight vehicles used in country districts are also furnished with springs, and the extensive use of such vehicles and of carriages has led to the general abandonment of the custom common in many sections until the nineteenth century was well advanced of conducting many minor freight movements on horseback.

Aside from the radical improvements effected by the substitution of steel springs for leather straps, and the application of steel springs to freight wagons of various classes as well as to carriages, great advances have been effected during the nineteenth century in connection with the materials and shapes of various parts of carriages, and the entire range of coach and wagon appliances.

Independent of the changes in external forms which vary with every freak of fashion, great advances have been made by adopting contrivances for preventing lubricating material from escaping; in substituting iron for wood in parts of vehicles where great strength is required; in improving axles, wheels, and the methods for fastening spokes to wheels; in increasing the facilities for turning within a short space; in designing vehicles specially adapted to a great variety of purposes; in arranging covers and providing for raising, lowering, and temporarily removing them; and in all the details of all the features of their mechanical appliances.

In the aggregate, these advances have made immense additions to the utility of wheeled vehicles and the number used has increased with great rapidity.

One of the influences affecting these improvements in a marked degree arises from the fact that all classes of wheeled vehicles are now intended almost exclusively for relatively short movements, consisting largely of trips to and from railway stations, instead of being frequently called into requisition for comparatively lengthy journeys, such as were often made in carriages and wagons before railways were constructed, and this change in requirements has been accompanied with marked improvements in methods of construction and a large number of additions to the classes of vehicles manufactured.

CHANGES IN AMERICAN VEHICLES.

Of the changes made in this country some of the most important are those which relate to the extensive substitution of four-wheeled vehicles for two-wheeled vehicles to be drawn by one horse; to the extensive use of springs under wagons intended mainly for the carriage of light freight, but which by having springs, can make journeys with greater rapidity than would be possible without their aid, and carry heavier loads with a given number of horses; to the introduction of cabs, hansoms, and omnibuses; to the improvement of stages; and to the organization of a large number of coach-building establishments by which all classes of demands and the most luxurious tastes can be gratified.

The gig, chair, or chaise, a light two-wheeled vehicle, was the favorite pleasure carriage to be drawn by one horse up to a period when the nineteenth century was well advanced. The famous description of the Deacon's one-horse shay, by Oliver Wendell Holmes, announces that it was manufactured in 1715 so perfect and well balanced in all its parts that it remained in good running order for exactly one hundred years and then suddenly fell to pieces. This might be accepted as a figurative description of the fate of the class of vehicles it represented. The "wonderful one-horse shay" was constructed on the theory that each place should be made "uz strong uz the rest."

In many sections changes have occurred analogous to those depicted in the following statement made by a Minneapolis carriage dealer to a reporter in 1885:—

"The changes in my business in the last twenty-five years," said a pioneer carriage dealer, "illustrate the whole growth and development of the country in that time. The first things we sold, I remember, were heavy transfer wagons, such as were suited to carrying heavy loads, and would last a long time. We did not think of selling anything else in those days. The appearance of that handsome barouche which you see yonder would have given us as much surprise as it would one of the painted warriors who roamed the prairie. About all the transportation except that by river was by means of these wagons, drawn by the stout horses of the pioneers. But times are changed. The roads became better, and such strong vehicles were not needed. Moreover, with the advent of more railroad lines, the teamster's occupation gradually dwindled. Strong wagons gave place to those of a lighter build. In time, too, the farmers began to indulge in luxury. They bought light spring wagons with which to go to town and church, and for a while trade was brisk in light wagons. But the country was growing all the time, of course, and soon there arose quite a demand for buggies. The farmers and trades-people, you see, were growing wealthy. Finally we abandoned the sale of heavy wagons altogether, and dealt only in buggies, carriages, and sleighs, and their furnishings. That little story, sir, marks the growth of this section of the country from a wilderness to a land of plenty. Perhaps you do not appreciate all the art there is in the make-up of a fine carriage and its accoutrements. A business man with an income of $5,000 a year can now ride out in more real style than Cæsar could. There is more art in his outfit. Take our phaetons, rockaways. They are simply the perfection of mechanical art. If they were handled rightly, I do not see why they should not wait and go in pieces all at once, as did the deacon's shay. And as to winter equipage, just step to the window and look out."

The reporter obeyed and, while entertained by the conversation of the loquacious dealer in carriages, watched the gay procession of winter merry-makers go by. There were cutters worth $50, and large double sleighs worth $500. Their furnishings were ali that wealth and a desire for comfort and even luxury could suggest. Drawn by sleek, high-stepping steeds, with silver or brass-mounted trappings, they made a moving and highly attractive picture. With immense crimson plumes and luxurious robes, with a driver in livery perched up in front, and the fascinating Minneapolis beauty behind, there was little to be desired.

THE VARIETY OF FINE CARRIAGES

manufactured is also indicated by the following newspaper notice of a display recently made by a prominent New York manufacturer:—

"There never before was shown so comprehensive a variety of carriages, embracing all classes of vehicles and all peculiarities of taste. A special effort was made, and with signal success, to show the late adaptations of the eight-spring apparatus. It figures in victorias, broughams, landeaus, phaetons, vis-a-vis, and other wagons, and makes a superb mounting, as light and as graceful as a hammock. Spider phaetons will continue to be popular this year, and a number of these, making a stylish turnout, were shown. There was a large variety of ladies' driving phaetons, and many handsome shapes of that usually unlovely vehicle, the landeau. Coupés and other closed carriages were also exhibited in large numbers. Many patterns were shown in wood and iron, so that the quality of material and workmanship might be fully observed.

"Among the special exhibits was a lithe, little sulky that weighed only thirty-seven pounds, and is warranted to endure the strain of the fastest possible speed. It is braced with steel couplings wherever the strain is apt to be severe. A magnificent tandem cart is displayed, which has just been made on the order of a well-known resident of Fifth avenue. A four-in-hand coach in wood and iron is shown, in which the massiveness of this wagon, as well as its wonderful running qualities, are revealed. There were also a host of two-wheelers of all weights, adapted for every sort of horse, from the pony to the coach horse. Light-weight wagons will be in extensive use this summer and fall, and the display of these is especially large and elegant. T-carts, dog-carts, village-carts, stand-up phaetons, and every style of small wagons were included. A peculiarity of this year is the new ruby color, a shade bordering on maroon. Trimmings in this color and in green and blue were those most largely used. Striping continues to be of all possible shades."

IN RURAL DISTRICTS,

where the number of persons who can afford to use very expensive carriages is comparatively limited, useful vehicles of various classes have been extensively introduced, which combine strength and adaptation to rough roads, and springs, that avoid excessive jolting, with comparative cheapness. In some regions buckboards, holding two, four, or nine passengers, have long been a favorite conveyance. In others the dearborn maintained a protracted ascendency. In others light wagons with springs used generally in moving light freight, such as delivering barrels of flour and carrying small quantities of grain to a mill, are frequently pressed into service for short passenger movements. In others a modification or close imitation of the army ambulance is used, which combines, in a marked degree, strength and adaptability to rough roads, with an avoidance of uncomfortable jolting.

INCREASE IN NUMBER OF WAGONS AND CARRIAGES.

The increase in the number of carriages and wagons used has been even more noticeable than the improvements in their construction. Instead of railways diminishing the number of common road vehicles they seem to have had the opposite effect. This, at least, seems to be a natural deduction from the following statements, compiled from census statistics, relating to the manufacture of carriages and wagons in the United States:—

Census year.	No of establishments.	Persons employed.	Wages paid.	Carriages produced.	Value of raw material.	Value of annual product.
1840......	92	2,274	....	13,32t	....	$1,708,741
1850......	1,822	14,000	....	95,000	....	12,000,000
1860......	7,234	37,457	$13,547,356	270,000	$12,008,675	35,927,192
1870......	11,944	56,294	21,749.625	800,000	23,385,683	67,003,730

The compendium of the tenth census (1880) gives the number of establishments engaged in manufacturing carriages and wagons as 3,841, with $37,973,493 capital, employing 43,630 males above 16 years, 273 females, and 1,491 children and youths, paying $18,988,615 in wages and $30,597,086 for materials. Their annual product is estimated at $64,951,617. A reference is made to wheelwrighting. The number of establishments reported under that head was 10,701, with a capital of $10,641,080, employing 16,108 persons, paying $5,074,799 for wages, and $6,703,677 for materials, and the annual value of products was $18,892,858. Reference is also made to blacksmithing, a considerable portion of which is devoted to making and repairing carriages and wagons. The number of establishments was 28,101, with a capital of $19,618,852, employing 34,526 persons, paying $11,126,001 in wages and $14,572,363 for materials. The annual value of their products was $43,774,271.

It is supposed that the number of carriages and wagons of all descriptions now made and sold, annually, exceeds 1,000,000, and their value is approximately about $100,000,000. The variety of carriages, including shapes, styles, and sizes is probably about 1,000. Important centres of carriage-making industries include Concord, New Hampshire; Amesbury and Belchertown, Massachusetts; New Haven and Bridgeport, Connecticut; Troy, New York; New York city; Newark, New Jersey; Philadelphia; Wilmington, Delaware; Pittsburgh; Chicago, and various other cities. There are, indeed, few cities or large towns in the United States in which a large number of carriages and wagons are not produced. One of the largest wagon-making establishments is located in Indiana, and from its works a large number of wagons are forwarded to western states and territories as well as to interior districts of seaboard states.

COMBINED EFFECT OF IMPROVEMENTS OF ROADS AND VEHICLES.

It would be impossible to apportion with exactness credit for the progress achieved in diminishing the time required for given journeys made in carriages or stage-coaches, and in increasing the amount of freight that can be drawn in vans or wagons, between those who improve roads and those who improve vehicles, but some of the particulars relating to the joint effect of both these advances may be appropriately mentioned. In regard to the cost of transportation over English turnpikes or roads in stage-coaches and wagons, John Macneil, an English civil engineer, presented the following estimate to a select committee of the House of Commons, in September, 1831:—

Expense of drawing one ton one mile at different rates of acclivity and different speeds by stage-coach and wagon.

Four-horse stage-coach, average velocity 10 miles per hour. Rates of acclivity.		Pence and decimals.	Wagon, four horses, average velocity 2½ miles per hour. Rates of acclivity.		Pence and decimals.
1 foot in	10	77.24	1 foot in	10	52 07
"	15	57.78	"	15	28.70
"	20	50.47	"	20	22.83
"	30	44.15	"	30	18.55
"	40	41.25	"	40	16.79
"	50	39.56	"	50	15.82
"	60	38.46	"	60	15 20
"	70	37 68	"	70	14.77
"	80	37.09	"	80	14.46
"	90	36.64	"	90	14 22
"	100	36.28	"	100	14 04
"	150	35.19	"	150	13.46
"	200	34.64	"	200	13.18
"	300	34.09	"	300	12.91
"	500	33.65	"	500	12.69
"	1,000	33.32	"	1,000	12.53
Horizontal		32.98	Horizontal		12.36

COST OF EXTENSIVE ROAD MOVEMENTS IN THE UNITED STATES.

These English rates or charges are higher than those which usually prevailed in the United States, except when bad roads, elements of danger, or a depreciated currency affected prices.

Jonathan Knight, chief engineer of the Baltimore and Ohio, said in 1832: "The charge for the carriage of commodities from Baltimore to Wheeling, on the turnpike road, averages about 2 cents per pound, or $44.80 per ton on the whole distance of 266 miles, being at the rate of about 17 cents per ton per mile."

A pamphlet published in 1882, entitled "Nebraska and the Territories, as developed by Railway Building and Operated," says:—

"By railroad now the rate to Denver is $1.87 per hundred, and car loads 75 cents. Time, two days—a saving of 50 days and over $9 per hundred over 1860.

To Salt Lake now the rate is $2.63 per hundred and $1.37 in car lots; time, 4½ days, a saving of nearly six months in time, and over $25 per hundred.

The interest saved on these goods during transit is no small item. One merchant in Salt Lake paid one hundred and fifty thousand dollars in one year for freights from the Missouri river.

In 1865 the rate by teams to Ogden was $27.84 per hundred. Now, by rail, $2.63, and by car loads, $1.37.

The cost of government transportation to Utah that year was $1,524,119. The cost of grain and transportation over the same route was $2,526,728. The cost of a bushel of corn delivered at Kearney was $5.03; Laramie, $9.26; Denver, $10.05; Salt Lake, $17.

To June 30, 1872, the statement of the war department shows a saving by railway transportation of $6,507,282. At this rate, up to 1882, presuming that the same amount was transported, the total saving by the government since the building of the railway would be $17,342,752; and including Indian goods, navy department, currency, etc., a grand total of over $34,000,000 saved by the government.

By Ben Holliday's coaches in 1860 the fare to Denver was $175. Reduced in 1862 to $150. Time, 72 hours. Now by the Union Pacific Railway the fare is: First class, $25; second class, $22.50; emigrant, $20. Time, 24 hours.

At the same dates the fare by coach to Salt Lake was $300. Time, 6 days. Now by rail the fare is: First class, $62; emigrant, $42. Time, 54 hours.

The fare by coach then to San Francisco was $500. Time, 16 to 18 days. Now the time is 96 hours and the fare, first class, $100; second class, $75; emigrant, $45.

In connection with the great reduction of fares is the reduced cost of living. In early times the cost of meals to San Francisco would not be less than $60.

The amount of fare paid then did not represent what it cost nor the discomfort of being cramped in a stage-coach days and nights in winter, nor the poor meals and slow travel. Those who once suffered the trip to Denver, Salt Lake, and across the continent can realize the comfort of day coaches and the luxury of sleeping cars. Certainly the government did not overestimate the benefits to the people when it encouraged the building of the great railway."

In 1865 stage fare from Nebraska City to Fort Kearney, 177 miles, or from Omaha to Fort Kearney, 197 miles, was $15.

In a conversation with a Chicago Tribune correspondent, Judge Taft, of Cincinnati, dwelt at some length upon the progress of Ohio railroads. We present herewith the substance of his remarks upon that topic:—

"It is astonishing to me as I travel over the state of Ohio in my campaigning tours and see how she has developed in every conceivable way since 1835, when I first put my foot within its borders. Then such a thing as a railroad was not known here. I came over the mountains of Pennsylvania from New York in a slow-moving stage and by canal when that mode of travel was available. I crossed the Ohio at Wheeling, and from that point we took the stage-coach, as the water was too low to make navigation safe. I well remember the slow and tedious trip from Wheeling to Cincinnati, and the extortion of the stage line, which held an undisputed monopoly of all the travel in those days. I paid the sum of $32 and some cents to be carried from Wheeling to Cincinnati; a sum which was by no means insignificant to a somewhat impecunious young lawyer who had just been admitted to practice. The coaches were crowded much beyond the point of comfort all the way, and often approached well-nigh suffocation. We were twelve days in making the trip, and on the whole I think we bore it nobly."

It is stated that in the palmy days of stage-coaching, the usual fare from New York to Albany was $12, and from New York to Boston $15.

TRANSPORTATION OF PASSENGERS IN STAGES.

THE era of primitive stage-coaches for the transportation of passengers and their baggage and light parcels exclusively, probably began in this country with the introduction of the "flying machines" first used on the road between Philadelphia and New York in 1766. They reduced the time required in summer to two days, and corresponding reductions were made about the same period in the time required for journeys between populous English and Scotch cities.

MOVEMENTS TO AND FROM BOSTON, AND BETWEEN BOSTON AND NEW YORK.

A year later, in 1767, an advertisement of a stage-coach, intended to carry passengers between Boston and Providence "all the summer season," appeared in the Boston Post during the months of August, September, and October. It was signed by Thomas Sabin, who only claimed to have one stage-coach, but stated that he had provided himself with several sets of good horses, and that he was prepared to carry travelers expeditiously at cheap rates. In 1770 a new stage-chaise commenced running between Salem and Boston, and in 1771 a line which boasted of a post-chaise lately improved by John Noble, and another curricle improved by J. S. Hart, commenced running between Boston and Portsmouth.

In describing the traveling between Boston and New York towards the end of the last century, President Quincy, of Harvard College, said: "The carriages were old, and the shackling and much of the harness made of ropes. One pair of horses carried us eighteen miles. We generally reached our resting place for the night, if no accident intervened, at ten o'clock, and after a frugal supper went to bed, with a notice that we should be called at three next morning, which generally proved to be half-past two, and then, whether it snowed or rained, the traveler must rise and make ready, by the help of a horn lantern and a farthing candle, and proceed on his way over bad roads, sometimes getting out to help the coachman lift the coach out of a quagmire or rut, and arrived in New York after a week's hard traveling, wondering at the ease as well as the expedition with which our journey was effected."

Later in the last century a decided improvement had been effected, as shown by the following advertisement in the Columbian Centinel for April 24th, 1793: "Boston and New York stages. The subscriber informs his friends and the public that he, in company with the other proprietors of the old line of stages, has established a new line from Boston to New York for the more rapid conveyance of the mails. The stage carriages of this new line will be small, genteel, and easy, in which but four inside passengers will be admitted, with smart, good horses, and experienced and careful drivers. They will start from Boston and New York on the first Monday in May, and continue to run three times a week until the first of November, and will leave Boston every Monday, Wednesday, and Friday at four o'clock A. M., and arrive at New York in three days and a half from their departure. They will leave New York on the same days at one o'clock P. M., and arrive at Boston on the fourth day from their departure at seven o'clock P. M. The number of passengers being so small, conveyance so agreeable and rapid, the price for each passenger will be 4d. per mile, with 14 pounds of baggage *gratis*, and as the proprietors have been at such great expense to erect this line, they hope their exertions will give satisfaction and receive the public patronage."

Besides the above "Fast Line," the proprietors advertise another line, occupying four days for the trip, the price being 3d. per mile per passenger, with 14 pounds of baggage *gratis*, and for every 150 pounds of baggage the same as a passenger.

In 1818

THE EASTERN STAGE COMPANY

was chartered in the state of New Hampshire. This was a notable event, and probably had a marked influence in encouraging the development of the famous Concord coaches. The capital stock was fixed at first by the company at 425 shares, of one hundred dollars each, and the charter extended for twenty years. The main route of this line in 1818 was as follows: A coach left Portsmouth for Boston at 9 o'clock A. M., dined at Topsfield, and then through Danversport and Salem to Boston, and back the same way the next day, dining at Newburyport. In 1825 the directors had established a sinking fund, and had carried $1,000 to that account, had declared a semi-annual dividend of four per cent., and had created 75 new shares, making up the full 500 allowed by the charter. The second dividend for this year was six per cent., and in 1826 eleven per cent. was divided. In 1828 the shares were at a premium of $50, and a semi-annual dividend of eight per cent. on $150 was made. In 1830 the company was incorporated in Massachusetts, with a capital of $100,000. In 1832 it was running coaches from Concord to Portsmouth, from Dover by two routes to Newburyport, from Portsmouth to Newburyport, Salem, and Boston, from Salem to Haverhill and Lowell, from Gloucester to Ipswich, and from Lowell by two routes to Newburyport. In 1833 the company was free from debt, and owned 500 horses, with equipment to correspond. In 1834 the stock stood at over $200 a share, par being $100. In 1835 the company was paying from $8,000 to $9,000 in tolls annually, and owned a large amount of turnpike, bridge, bank, and hotel stock. It was over this line that Henry Clay was carried from Pleasant street in Salem to the Tremont House in Boston in sixty minutes, and upon this route Daniel Webster was carried from Boston to Portland, to sign the Ashburton treaty, at the rate of sixteen English miles an hour.

MOVEMENTS BETWEEN PHILADELPHIA AND BALTIMORE.

The Philadelphia Independent Gazetteer, of January 2d, 1788, contains an advertisement of Greshom, Johnson & Co., of "the Philadelphia, Baltimore and Eastern Shore Line of Post-Coach Carriages," which announces that carriages will set out in Fourth street, nearly opposite the Old Indian Queen Tavern, during the winter, on Mondays and Thursdays of every week, at ten o'clock in the forenoon, and arrive in Baltimore on Wednesdays and Saturdays in good season for dining. In the issue of July 12th, 1788, the rates of fare are given, thus:—

From Philadelphia to Chester, 15 miles	£0 5s. 0d.
From Chester to Queen of France (a total of 22 miles from Philadelphia, where passengers dined), 7 miles	£0 2s. 6d.
Queen of France to Wilmington, 6 miles	£0 2s. 6d.
Wilmington to Christiana bridge, 10 miles	£0 3s. 4d.
Christiana bridge to Elk, 12 miles	£0 4s. 2d.
Elk to Susquehanna, 16 miles	£0 7s. 6d.
Philadelphia to Susquehanna, 66 miles	£1 5s. 0d.
Susquehanna to Baltimore, 37 miles, gratis.	

The passengers sleep the first night at Christiana bridge."

It will be seen that the principle of charging a higher rate for short movements than for longer ones was adopted by this line to the extent of moving passengers over more than a third of the distance gratis, probably to meet water-route competition.

The announcements were headed by a picture of the post-coach carriages of that day. They resembled very large dearborns or market wagons, with round tops covered with canvas. The driver was seated at the front, his feet outside of the body of the wagon, resting on a foot-board. The vehicle was drawn by four horses.

Of a journey made by Josiah Quincy, from Philadelphia to Washington, via Lancaster, the following entry occurs in his diary:—

"*February 10th, 1826.*—At three o'clock this morning the light of a candle under the door and a rousing knock told me that it was time to depart, and shortly after I left Philadelphia by the Lancaster stage, otherwise a vast, illimitable wagon, with seats without backs, capable of holding some sixteen passengers with decent comfort to themselves, and actually encumbered with some dozen more. After riding till eight o'clock, we reached the breakfast house, where we partook of a good meal, and took up Messrs. Story and Wheaton. We then proceeded through a most beautiful tract of country, where good fences and huge stone barns proved the excellence of the farming. The road seemed actually lined with Conestoga wagons, each drawn by six stalwart horses, and laden with farm produce."

In a statement made to a Washington correspondent of the New York Sun by Colonel John E. Reeside, son of James Reeside, the first of the heavy mail contractors in the United States, he said that from 1827 to 1836 he carried passengers and the mails between Philadelphia and Baltimore, during the season of navigation as follows: From Philadelphia to New Castle, Delaware, by steamboat; from New Castle in coaches across the peninsula, sixteen miles, to Frenchtown, and then to Baltimore by steamboat.

In the winter, when navigation was closed, two stage lines were run from Philadelphia to Baltimore. The time between Philadelphia and Baltimore by the Wilmington line was usually twenty-four hours, but when the roads were bad sixty hours were frequently consumed. By the river route the usual time was eleven hours. About 1829 or 1830 the New Castle and Frenchtown Railroad was built. The cars used on this line were simply the Troy coach bodies swung on straps and elliptic springs, and placed on trucks, and drawn by horses driven tandem. This was one of the first railroads in the United States on which steam was used.

MOVEMENTS BETWEEN PHILADELPHIA AND PITTSBURGH.

Colonel Reeside also states that in 1828 he began to carry the mails between Philadelphia and Pittsburgh. There were two lines owned by Reeside, Slaymaker & Co., one carrying the letter mail, called "The Good Intent." The other, carrying the newspaper mail, was known as "The Telegraph." "The Good Intent" ran by the way of Harrisburg, Chambersburg, Somerset, and Mount Pleasant to Pittsburgh; "The Telegraph" by the way of Columbia, York, Gettysburg, Chambersburg, Bedford, and Greensburg to Pittsburgh. "The Good Intent" made the run from Philadelphia to Pittsburgh in fifty-two hours, while "The Telegraph" consumed seventy-two hours. In 1834 the speed of "The Telegraph" line was brought up to that of "The Good Intent," for which additional pay amounting to $12,000 a year was given by the department.

In Mr. W. Hasell Wilson's Notes on the Internal Improvements of Pennsylvania, published in 1879, he says:—

"An announcement was made in the Pittsburgh papers, of May 1831, that Reeside, Slaymaker & Co. had, with their usual enterprise and public spirit, established four lines of stages to run through to Philadelphia; the first, in two and a half days; the second, in four days, both of them daily; the third to start tri-weekly, and the fourth to run daily in four days, by the way of Blairsville, Huntingdon, and Lewistown. This was considered at the time a great advance upon the previous traveling facilities. The writer well recollects the advent of the fast mail line, to run through in two and a half days. The coaches were built as light as possible consistent with strength, and carried but six passengers each. The four-horse teams were carefully selected, and changed every ten miles. As the sound of the horn announced the approach of the stage to the changing station, the fresh horses were brought out, each in charge of a groom, and the change was effected, and the coach rolling away before the passengers hardly realized what was being done. The contrast with the old order of things was so marked as to excite a good deal of wonder and astonishment along the route."

COMBINED RAIL AND SLEIGH MOVEMENT BETWEEN PHILADELPHIA AND NEW YORK.

In reference to a winter substitute for staging, viz., riding on sleds or sleighs, Mr. S. W. Roberts said, in an address to the Pennsylvania Historical Society:—

"On the 14th of February, 1836, I left Philadelphia at 5 P. M., and was fourteen hours going to New York with the Great Southern Mail, although the sleighing was good. We rode in an open sled, or box on runners, and the four passengers sat on the mail bags. The fare from Philadelphia to New York was six dollars. . . . My recollection is that we rode fourteen miles in a railroad car, from Elizabethtown to Jersey City."

STAGE MOVEMENTS FROM ALBANY TO WESTERN NEW YORK.

Thurlow Weed's autobiography says: "Very few of our citizens possess information, other than traditional, of the mode of travel between Albany and the western part of New York even as late as 1824. Those who step into a railway car at Albany at seven o'clock in the morning, and step out to get their dinner at Rochester at two o'clock P. M., will find it difficult to believe that within the memory of by no means the 'oldest inhabitant' it required, in muddy seasons of the year, seven nights' and six days' constant traveling in stages to accomplish the same journey; and yet that was my own experience in April, 1824.

"We left Albany at seven o'clock in the evening, and traveled diligently for seven nights and six days. The road from Albany to Schenectady, with the exception of two or three miles, was in a horrible condition, and that west of Schenectady, until we we reached 'Tripes,' or 'Tribes Hill,' still worse. For a few miles, in the vicinity of Palatine Church, there was a gravelly road, over which the driver could raise a trot, but this was a luxury experienced in but few localities, and those far between. Passengers walked to ease the coach several miles each day and each night. Although they did not literally carry rails on their shoulders to pry the coach out of ruts, they were frequently called upon to use rails for that purpose. Such snail-paced movements and such discomforts in travel would be regarded as unendurable now; and yet passengers were patient, and some of them even cheerful, under all those delays and annoyances. That, however, was an exceptional passage. It was only when we had 'horrid bad' roads that the stages 'drew their slow length along.'"

OF SOUTHERN STAGE LINES AND STAGE TRAVELS IN 1834

A writer in the Dooly (Ga.) Vindicator says: "As a great many of the young people of these days have but a faint idea how the public traveled in old times, some forty-nine years ago, I thought I would, for their information, give them, through the columns of the Vindicator, a few dots, by commencing back in 1834, when there were no railroads in Georgia. About the end of 1834, Messrs. John and Richard Stockton, of Virginia, started a line of stage coaches from Augusta, Ga., to Mobile, Ala., passing through this, Dooly county, and through Vienna. It was arranged for the stages to run every other day, the stands or points where teams were changed were from ten to fourteen miles apart, according to the facilities for entertainment, except on long drives, which were from twenty to twenty-five miles apart, and at each one of these stands they kept a team of four horses of the best kind, each horse had a set of harness, each team had its driver, each driver had his whip, water bucket, grease bucket, and stage horn, and the stages ran on stage time, so each driver would know when the stage was due at his stand. The driver would always have his horses harnessed in time, and when he heard the driver on the road coming blowing on his horn, 'Molly, Put the Kettle On,' he would have his team on the spot ready to take the coach on. They kept the stages running all the time, Sundays not excepted.

These coaches varied in size, having a capacity for carrying six to fourteen passengers, though when it was a fourteen-passenger coach, two had to be deck passengers. This line carried through passengers for ten cents a mile; way passengers were charged twelve and a half cents a mile.

Every coach that left Augusta or Mobile had in it a way box, in which was a way bill, and on that bill every passenger registered his or her name; when they took passage, any person could have access to that bill by going to the driver at the stage stand, for it was the duty of every driver to see that every passenger's name was registered and the fare paid, and if any driver found a passenger on who had not paid his fare it was his duty to collect it or put him off.

This line was laid out in sections, each section had an agent, and these agents would travel over their sections about once in every fifteen or twenty days, but would go when the drivers were not expecting them. It was also the agents' duty to pay the drivers and pay for forage, for harness, etc., to look after the condition of the stables and teams, and to see that all was right, for if any driver had not accounted for all money received from every passenger, the agents settled with such defaulter by deducting the amount behind from his wages, besides all damages caused by fault of such driver, and put him on the road to leave.

The line was about four hundred miles long, it carried the United States mail at a considerable cost, and when a trip was lost it was no little item to the contractor. This line of stages ran for five years, and was a great advantage to the country which it ran through."

STAGE-COACH MOVEMENTS ON THE CUMBERLAND ROAD.

One of the greatest theatres of prolonged stage-coach activity, involving the use of superior vehicles and teams, was the Cumberland road, which for a number of years was a leading avenue of travel between the Atlantic and western states, and especially for movements between Wheeling and Baltimore. In describing these movements, a Washington, Pa., correspondent of the Philadelphia Press says:—

"At various times four companies engaged in staging. They were the National Line, Good Intent, June Bug, and the Pioneer. Of the few surviving drivers, none recollect how the 'June Bug' Line received its name. Relays were established at a distance of from ten to twelve miles, and there are some records of quick changing that would make a modern Jehu turn green with envy. An old driver still boasts of harnessing his four horses in four minutes, and of changing teams before the stage ceased rocking. Ponderous trunks were strictly forbidden, each passenger being limited to fifty pounds of baggage, and there was careful weighing in those days. Each stage's complement consisted in not more than nine passengers. As many as fourteen coaches have traveled together with their 100-odd passengers. If there was a mail coach among them, the 'toot,' 'toot' of the driver's horn added to the gaiety of the scene; and when a wayside inn was reached, and the passengers disembarked for refreshments, what joyful recognition, uncorking of bottles, and the like were there! In those days through mail coaches left Wheeling at 6 A. M., and just twenty-four hours later dashed into Cumberland, Md., having traversed a distance of 132 miles. Occasionally there were delays, but these were not permissible upon the completion of the Baltimore and Ohio road to Cumberland. A way mail coach, which both deposited and received mail at all stations, left Wheeling at 7 A. M. each day. Despite its extra duties, it managed to overtake the through mail before entering Cumberland. Ohio river steamboats have arrived at Wheeling as late as 10 A. M. with passengers booked for the train to leave Cumberland at 6 o'clock the next morning. One hundred and thirty-two miles up hill and down hill, fording rivers and crossing mountains, but connection must be made; and it was, though at a heavy cost to the company. Such fast trips, however, could only be indulged in by the wealthier classes.

"The stage drivers were ambitious. A true test of their mettle was the delivery of the President's message. The letting of contracts by the Post-Office Department hinged on these deliveries, and if a driver failed to make good time it meant the cancelation of the contract with his employers, and the transfer to a rival company. Dave Gordon, a noted driver, once carried the President's message from this point to Wheeling, a distance of 32 miles, in two hours and twenty minutes. He changed teams three times in this distance. Bill Noble, still living, and further afflicted with a cancer on the face, claims to have made the best time on record. He professes to have driven from Wheeling to Hagerstown, Md., 185 miles, in fifteen and a half hours.

"In 1852 coaching began to decline. In that year the Baltimore and Ohio Railroad was completed to Wheeling, and thereafter stages to and from Cumberland were propelled by two horses instead of four. Now it has dwindled down to an aged-looking coach, which plys daily between here and Brownsville, 24 miles east. The iron horse enters both places, and this relic of olden days contents itself with a local traffic. The dog trot of to-day is a miserable contrast to the quick time of thirty-five or forty years ago. Then drivers' orders were to make the time or kill the horses. Teams were driven ten miles at a full run. If a horse dropped he was quickly unharnessed, and if unable to travel further was drawn aside, and the journey was resumed."

In a description of movements over the Cumberland road, furnished to the New York Sun by Colonel Reeside, he stated that in 1836 he turned his attention to the connections from Baltimore westward. The National road between Cumberland and Wheeling being then about completed, he placed lines upon that route to make the connection between the terminus of the Baltimore and Ohio Railroad at Frederick and the steamboat service on the Ohio river at Wheeling, and the stage lines running west into Ohio and Indiana. He reduced the time of transit from Baltimore to Wheeling to about forty-eight hours. The road being new, the stone just broken, the teams employed usually consisted of five horses, three in the lead and two at the wheel. There was a strong opposition between the lines of Reeside and Stockton, and it was frequently the scene of spirited races between the rival lines. At that date most of the freight for the west was conveyed from Baltimore and Frederick to Wheeling and points in the west beyond, with the old-fashioned Conestoga wagon, which, together with the numerous droves of cattle, sheep, and hogs driven to market, frequently caused great obstruction to the stage coaches in getting by and through them. Those were the days of the good old-fashioned roadside inn, where venison steaks, hot waffles, corn cakes, and coffee were the bounteous repasts served up to the hungry traveler.

Competition being very great at that time for the possession of the mail contract, Amos Kendall, then Postmaster-General, designed a wagon for the purpose of carrying the mail, independent of passenger travel, which was tried but a short time and then laid aside, and the mail placed upon the ordinary coaches. It frequently required three or four coaches to transport it, there being often as many as fourteen lock bags and seventy-two canvas sacks.

In 1846 the Baltimore and Ohio Railroad reached Cumberland. The travel over the National road was then greatly increased. Competing stage lines were put on, and it was no unusual thing to see from fifteen to twenty coaches leave and enter Cumberland twice a day. There was a corresponding increase of the traffic by wagons, so that the saying of "Forty wagons in a day entering Wheeling" became a proverb. The great stream of travel between the east and the west poured over the National road from that time on for several years. In 1852 the Baltimore and Ohio Railroad reached the Ohio river, and it remained for the son of the father who started the first line of stage coaches across the Alleghany mountains with the daily mail, to carry the last mail for the east by coach into Wheeling.

"After 1852," says John E. Reeside, "I began to run coaches through Ohio, Indiana, and Missouri, and across the plains and the Rocky mountains to Salt Lake. In 1815–16 my father was concerned in the first line of coaches crossing the Alleghany mountains and carrying the mails. In 1852 the first mail coach crossing the Rocky mountains was owned by myself and William McGraw. The contract for carrying the mails across the Rocky mountains was terminated by Indian hostilities, culminating in what was known as the Harney war."

ORIGIN OF THE PHRASE "CHALKING HIS HAT," OR THE FREE-PASS SYSTEM.

The Washington Critic says: "The first man to introduce the hat-chalking business in this country was Mr. Reeside, father of Mr. J. E. Reeside, of Washington. Away back in the days of Old Hickory, the first-named gentleman, in connection with others, was the great Star-Route contractor of the Union. Mr. Reeside and his friends ran lines of stage coaches from this city to all the leading points in the west and south-west. Mr. Reeside was agent of the company for this city, and knew all the M. C.'s from the sections named. Occasionally he would take a liking to some Representative or Senator, and would tender him a free ride to his home when Congress adjourned.

Now, the old man was mighty strict with his drivers and agents, holding them pecuniarly responsible for the fare of everybody who got onto the coaches. To prevent his agents being imposed upon by forged passes, the old man devised a peculiar hieroglyphic. The M. C. would have his name printed on the *inside* of his hat, and Mr. R. would take a piece of chalk and write his hieroglyphic on the *outside* of the hat.

In a short time Mr. R.'s mark became known on all the lines, and a man with that mark on his tile could ride all over the west and south-west gratis, because, as the drivers expressed it, 'the old man's chalked his hat.' Thus Mr. R. became the forerunner of all the chalk-daubing now in the United States. This is a fact, as the writer had it from the lips of Mr. J. E. Reeside, who has seen his father sling the chalk many a time in days long gone by."

THE PRIMITIVE WESTERN STAGE COACH,

dating back to 1830, was described as follows in the Chicago Magazine: "It was a great, ugly, inconvenient, incommodious vehicle, built with an eye to service, without a thought of elegance. The wheels were of oak, with spokes like a Polynesian war-club, thickly tired, and with a hub like a hogshead. Upon the axle-trees was a common cart body, with seats laid across. There was no tongue to the coach, but a pair of shafts, and one horse alone did the duty, or mayhap a tandem. Hoop-poles were bent over from side to side, and a rough board behind, fastened to the coach by a pair of great leathern straps, carried the baggage of the passengers."

THE CONCORD COACH.

Of the stages generally used in the new western states and territories about 1865 Albert D. Richardson says: "The mail coach or hack built in Concord, N. H., is known as the Concord wagon. It is covered with duck or canvas, the driver sitting in front, at a slight elevation above the passengers. Bearing no weight upon the roof, it is less top-heavy than the old-fashioned stage coach for mud-holes and mountain sides, where to preserve the centre of gravity becomes, like Falstaff's instinct, 'a great matter.' Like human travelers on life's highway, it goes best under a heavy load. Empty, it jolts and pitches like a ship in a raging sea. Filled with passengers, and balanced by a proper distribution of baggage in the 'boot' behind, and under the driver's feet, its motion is easy and elastic. Excelling every other in durability and strength, this hack is used all over our continent and throughout South America."

Quite a variety of vehicles, however, were pressed into the service of stage proprietors. A writer, in describing the stages of Montana, says: "If there is a prettier street picture of animation than a red Concord coach, with six spirited horses in bright harness, and a good reinsman on the box, we have not seen it. But it was not always clean Concords and six prancing horses. There are the jerkeys and mud wagons, with two and four horses, and passengers packed in like sardines, or footing it through the mud at the rate of two miles an hour, in the dark background of memory on which the bright picture is painted."

STAGE-COACH MOVEMENTS WEST OF THE MISSISSIPPI.

In 1860, by traveling in stages during a large portion of each day and night, but halting forty-five times for intervals of from four to five or six hours, the journey was made from St. Joseph, Missouri, to Great Salt Lake, in 19 days, the distance being 1,126 miles, and the average rate of speed nearly sixty miles a day.

Hall's Guide to the Great West, published in 1865, says of a journey to Virginia City, Montana:—

"One route is by the overland stage from Atchison, Kansas, or from Omaha, Nebraska, to Salt Lake and Montana. The distance to Salt Lake is 1,255 miles and to Virginia City 500 miles further, requiring at least 17 days' and nights' continuous travel in a coach generally crowded to its utmost capacity, with only 25 pounds of baggage allowed to each passenger, except by paying $1.50 for every additional pound. The stage fare to Virginia City is $600; the price of meals on the way is from $1 to $2 each. These high rates, more than double what they were a year ago, are in consequence of the troubles with the Indians, who for a time completely broke up the line between the Missouri river and the mountains." The fare named, of $600 for 1,755 miles, is a little more than 34½ cents per mile.

The same work says that Holliday's and Butterfield & Co.'s stages left Atchison daily in 1865 for Salt Lake. Time 12 days, fare $150. This was about 12 cents per mile, and supposing that the additional $450 required for the journey to Virginia City, of 500 miles beyond Salt Lake, applied exclusively to payment for that journey, it was at the rate of 90 cents per mile.

The Ben Holliday stage lines, in operation in 1865 west of the Missouri, were probably then the most extensive and most skillfully conducted stage routes in the world. The main line ran from Atchison, Kan., to Placerville, Cal., a distance of 1,913 miles, and there were, besides, important branches leading from Omaha to Fort Kearney, from Denver to Central City, Col., and from Salt Lake City to Idaho. The average speed, continued night and day, including stoppages for meals, was between five and six miles an hour. The coaches were of the regular Concord pattern, with three comfortably cushioned seats, and similar in appearance and accommodations to the best style of coaches formerly used on first-class stage routes in the east. Except in times of unusual difficulty, the coaches moved with great regularity, the schedule time being as particularly made as on a railway.

OMNIBUS, CAB, AND GURNEY MOVEMENTS.

A class of vehicles, intended for hire, that have been extensively used are stages or omnibuses, and cabs, coaches, hansoms, and gurneys, employed mainly in large cities and towns. The omnibuses have been supplanted by street cars to such an extent that few of them are now running on their old routes. Like a number of other adjuncts of transportation, their rise, decline, and fall as principal agencies of local passenger movements in great cities extended over a period of about a quarter of a century, beginning about 1830 on some routes, and a few years later on others.

Some of the first omnibus lines were drawn by four horses, and had such names as the Lady Clinton, Lady Washington, Phœnix, Red Bird, Yellow Bird, and Blue Bird. Their exteriors were adorned with fantastic figures, and the entrance doors were on the sides of these vehicles. Subsequently the door for entering was placed in the rear, connected by a strap with the driver's box, so that he could know when any one was entering or leaving the vehicle, and two horses were used in nearly all cases, the only exceptions being very large omnibuses, capable of seating about thirty or more passengers, and used mainly in social excursions or moving persons between railway stations. As one omnibus line after another in large cities was supplemented by street cars, the old vehicles were usually painted anew in gorgeous colors, and pressed into service in the suburbs, or in country towns and country hotels. The charges for an omnibus ride, varying in length from a few squares to several miles, were originally a shilling. Subsequently they were reduced to five cents in some cities and six cents in others.

One of the varieties in usages relating to cabs has been transitions from one horse to two-horse vehicles, followed by a failure or abandonment of one-horse vehicles, and subsequently by their reappearance in new shapes. The two-horse coaches are used largely in connection with funerals, and an important portion of their revenue is derived from this service. On the other hand, the employment of one-horse vehicles has been considered one of the steps necessary to cheapen local carriage transportation. The rates usually charged for a two-horse coach for carrying one or two passengers not exceeding one mile, or between principal hotels or stations, was $1. The one-horse vehicles usually render the same service for 25 cents. The published rates of the Chicago Gurney Company in 1885, which correspond closely to the rates charged by the Hansom Cab Company of that city and similar organizations elsewhere, were as follows:—

ONE MILE	
One mile or less, from any stand, each passenger	25
Between principal hotels and depots, each passenger	25
TWO MILES.	
One passenger, from any stand	50
Two passengers	75
Three or four passengers	$1 00
THREE MILES.	
One passenger, from any stand	75
Two passengers	$1 00
Three or four passengers	1 25

In above rates no charge made for one stop or wait of five minutes, but for a stop or wait of ten minutes the charge will be 15 cents; for fifteen minutes, 20 cents; for twenty minutes, 25 cents.

No charge for ordinary hand-baggage.

SERVICE BY THE HOUR.	
One or two passengers	75
Three or four passengers	$1 00

Time counted both ways from stand whether gurney returns empty or otherwise, and no service performed for less than the price of one hour.

Charges made for fractions of an hour after the first hour.

Passengers desirous of using the gurney by the hour should make it known to the driver when engagement is made, otherwise the charges will be by the mile.

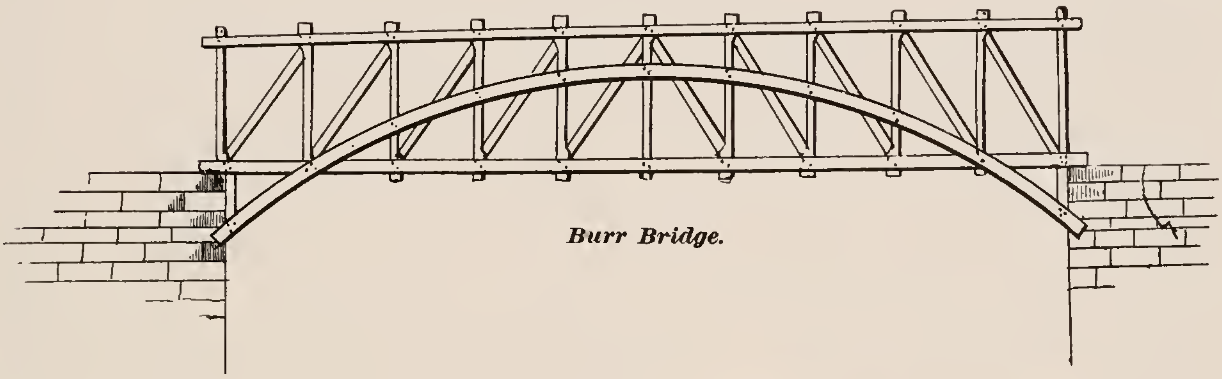
EARLY AMERICAN RAILWAY PROJECTS.

CONCEPTIONS OF OLIVER EVANS, JOHN STEVENS, AND ROBERT FULTON.

It would be difficult to trace each stage of the proceedings that finally led to the establishment of railways in the United States. At some periods few things were attempted which were not imitations of something that had previously been done in Great Britain. But this rule had notable exceptions, the first of which was the invention of a high-pressure engine, which, under favorable circumstances, could presumably have been developed into a successful primitive locomotive, by Oliver Evans, an able and successful inventor, at an earlier date than any equally important forerunner of the locomotive had been devised elsewhere. There were no railways in America at the period when Evans first conceived his plan of a steam-road wagon, and he was obliged to look, but in vain, for a field of practical utility, to turnpikes or a slight modification of them. He nevertheless was an ardent, although unsuccessful, advocate of steam railways, and he was the first citizen of the United States who combined with such advocacy positive proofs of ability to devise a machine capable of moving itself and additional weight by steam power, over ordinary streets or roads.

In a letter published in Niles' Register, dated November 13th, 1812, Oliver Evans describes at length the steps he had commenced, soon after 1772, to construct steam wagons, and to organize methods for applying them to useful service. He makes this reference to what was probably his most remark-

Fulton's Ferry System, 1812.



Burr Bridge.

Wernwag's Bridge Construction.

Suspension Bridge.

able original discovery: "At length a book fell into my hands describing the old atmospheric steam engine. I was astonished to observe that they had so far erred as to use steam only to form a vacuum to apply the mere pressure of the atmosphere instead of applying the elastic power of the steam for original motion; the power of which I supposed irresistible. I renewed my studies with increased ardor and soon declared that I could make steam wagons."

He states that in 1786 he petitioned the legislature of Pennsylvania for the exclusive right to use his improvements in flour mills and steam wagons in that commonwealth, and that the committee to whom his petition was referred heard him very patiently while he described his mill improvements, but were led to think him insane by his representations concerning steam wagons. He then made a similar application to the legislature of Maryland, which resulted favorably, mainly on the ground that the grant could injure no one, and the encouragement proposed might lead to the production of something useful. He describes interviews with various prominent merchants or other capitalists, in which he explained his ideas and plans, and unsuccessfully solicited pecuniary assistance to give them practical effect. He says that in 1800 or 1801 he constructed a small stationary engine for grinding plaster, which fully demonstrated the correctness of his theories. As an additional and unanswerable demonstration, he cites the success of the effort he made in 1804 to propel by steam through the streets of Philadelphia his machine for cleaning docks.

Of this he says: "It consisted of a large flat, or scow, with a steam engine of the power of five horses on board to work machinery to raise the mud into flats. This was a fine opportunity to show the public that my engine could propel both land and water carriages, and I resolved to do it. When the work was finished I put wheels under it, and, though it was equal in weight to two hundred barrels of flour, and the wheels fixed with wooden axle-trees for this temporary purpose in a very rough manner, and with great friction, of course, yet with this small engine I transported my great burthen to the Schuylkill river with ease; and when it was launched in the water I fixed a paddle-wheel at the stern, and drove it down the Schuylkill to the Delaware, and up the Delaware to the city, leaving all the vessels going up behind me at least half-way, the wind being ahead."

This remarkable demonstration of

THE PRACTICABILITY OF STEAM WAGONS,

as well as steamboats, by a single machine, at that early period, was one of the greatest triumphs of superior inventive and mechanical skill ever achieved. But either lack of faith or lack of capital prevented the immediate fruition which Mr. Evans so richly deserved, notwithstanding the continuance of appeals, which he forcibly describes in the following extracts:—

"Some wise men undertook to ridicule my experiment of propelling this great weight on land, because the motion was too slow to be useful. I silenced them by answering that I would make a carriage, to be propelled by steam, for a bet of $3,000, to run upon a level road against the swiftest horse they would produce. I was then as confident as I am now that such velocity could be given to carriages. . . . On the 26th of September, 1804, I submitted to the consideration of the Lancaster Turnpike Company, a statement of the cost and profits of a steam carriage to carry 100 barrels of flour 50 miles in 24 hours,—tending to show that one such steam engine would make more net profits than ten wagons drawn by ten horses each, on a good turnpike road, and offering to build such a carriage at a very low price."

In a practical test of such a proposition Mr. Evans would, of course, have been obliged to encounter difficulties similar to those which confronted other inventors who endeavored to promote the use of steam engines on turnpike roads, and he recognized the force of the conclusion which was one of the great secrets of the extraordinary success achieved by George Stephenson, viz.: That the rail and the locomotive should be regarded as man and wife.

Indications of this conviction are furnished by the following extracts from Mr. Evans' communication of 1812:—

"I am still willing to make a steam carriage that will run fifteen miles an hour, *on good, level railways*, on condition that I have double price if it shall run with that velocity, and nothing for it if it shall not come up to that velocity. . . . I have been highly delighted in reading a correspondence between John Stevens, Esq., and the commissioners appointed by the legislature of New York, for fixing on the site of the great canal proposed to be cut in that state. Mr. Stevens has taken a most comprehensive and very ingenious view of this important subject, and his plan of railways for the carriage to run upon removes all the difficulties that remained. I have had the pleasure, also, of hearing gentlemen of the keenest penetration, and of great mechanical and philosophical talents, freely give in to the belief that steam carriages will become very useful. Mr. John Ellicott (of John) proposed to make roads of substances such as the best turnpikes are made, with a path for each wheel to run on, having a railway on posts in the middle to guide the tongue of the wagon, and to prevent any other carriage from traveling on it. Then, if the wheels were made broad and the paths smooth, there would be very little wear. Such roads might be very cheaply made. They would last a long time, and require very little repair. Such roads, I am inclined to believe, ought to be preferred, in the first instance, to those proposed by Mr. Stevens, as two ways could be made, in some parts of the country, for the same expense, as one could be made with wood. But either of the roads would answer the purpose, and the carriages might travel by night as well as in the day."

This crude conception of a possible railway is followed by this striking prophecy of the actual course of events:—

"When we reflect upon the obstinate opposition that has been made by a great majority to every step towards improvement; from bad roads to turnpikes, from turnpikes to canal, from canal to railways for horse carriages, it is too much to expect the monstrous leap from bad roads to railways for steam carriages, at once. One step in a generation is all we can hope for. If the present shall adopt canals, the next may try the railways with horses, and the third generation use the steam carriage. . . . I do verily believe that the time will come when carriages propelled by steam will be in general use, as well for the transportation of passengers as goods, traveling at the rate of fifteen miles an hour, or 300 miles per day."

In a work published in or about 1813 he repeated in a still more emphatic manner, some of the ideas expressed above. He said: "The time will come when people will travel in stages moved by steam engines, from one city to another, almost as fast as birds fly, fifteen or twenty miles an hour. . . . A carriage will set out from Washington in the morning, the passengers will breakfast at Baltimore, dine at Philadelphia, and sup at New York, the same day. To accomplish this two sets of railways will be laid, so nearly level as not in any place to deviate more than two degrees from the horizontal line, made of wood or iron or smooth paths of broken stone or gravel, with a rail to guide the carriages, so that they may pass each other in different directions, and travel by night as well as by day; and the passengers will sleep in these stages as comfortably as they now do in steam stage boats."

COLONEL JOHN STEVENS, OF HOBOKEN,

whose advocacy of a railroad instead of a canal is referred to by Oliver Evans, was the first American who combined a very early championship of railway improvements with persistent and judicious efforts that finally led to important practical results. He commenced advocating the construction of railways in New York about 1810, and in 1811 applied to the legislature of New Jersey for the first American railway charter, which was granted in 1815. When the agitation of schemes for constructing a canal to connect lake Erie with the Hudson seemed to be assuming a practical shape in 1812, Colonel Stevens urged the New York commission of inland navigation, of which Gouverneur K. Morris was chairman, to construct a railway, instead of a canal, as a connecting link between those great water channels, and, although his suggestions were rejected, they helped to direct public attention to the practicability of improved iron highways, and they embodied the first clear conception of a lengthy and extensive railway. The comprehensive nature of his plans may be inferred from the fact that his outline of them, as furnished in February, 1812, was as follows:—

"Let a railway of timber be formed, by the nearest practicable route, between lake Erie and Albany. The angle of elevation in no part to exceed one degree, or such an elevation, whatever it may be, as will admit of wheel carriages to remain stationary when no power is exerted to impel them forward. This railway, throughout its course, to be supported on pillars raised from three to five or six feet above the surface of the ground. The carriage wheels of cast iron, the rims flat with projecting flanges, to fit on the surface of the railways. The moving power to be a steam engine, nearly similar in construction to the one on board the Juliana, a ferryboat plying between this city and Hoboken."

This conception closely resembled the New York elevated railways, and although it differs widely from the method of construction subsequently adopted by the lengthy steam lines, it was far in advance of the plans that had then been suggested by other inventors.

He supported his theory of the practicability of such a road by the following reasons: Its expense would be no greater than that of an ordinary turnpike road with a good coat of gravel on it; it could be built in one or two years; its elevation would remove the timber, of which it was composed, from danger of decay; and travel could never be impeded on it even by the deepest snows; it would be free from the casualties to which canals were liable, and the expense of transportation would be far less than on a canal.

In discussing the speed that could be obtained by passenger trains he said that he should not be surprised at seeing steam carriages propelled at the rate of 40 or 50 miles an hour. In reference to freight movements he estimated that a train of 160 tons could be drawn at a speed of four miles per hour, and that the actual expense of transporting a ton over the entire line would be fifty cents. He also made a detailed estimate of the cost of such a road as he proposed, having brick pillars, 400 to the mile, with timber ways and iron bar rails four inches broad and one-half inch thick. He made the cost per mile as follows:—

Bar-iron plates	$7,603
Brick pillars	1,600
Timber ways	1,500
	$10,703
Or, for the whole 300 miles	$3,210,900
For reducing elevations, etc.	500,000
	$3,710,900

At a much later period, probably about 1835, attempts were made to build a few railways in accordance with these plans, in south-western New York and north-eastern Ohio, but such projects were soon abandoned mainly on account of the perishable and insecure nature of wood as a supporting material and the inability to secure a sufficient amount of capital to purchase iron supports.

Thwarted in his attempt to secure a favorable consideration from the New York commissioners, Mr. Stevens published his suggestions in pamphlet form in 1812, and made an earnest effort to secure aid from the Federal Government for the purpose of having an experimental railway built, by which the feasibility of his plans could be tested. He claimed that for the moderate sum of $3,000 such a test could be made. In the introduction to the description of his plans, he said: "But I consider it (internal improvement by means of railways), in every point of view, so exclusively an object of national concern that I shall give no encouragement to private speculations until it is ascertained that Congress will not be disposed to pay any attention to it. Should it, however, be destined to remain unnoticed by the General Government, I must confess I shall feel much regret, not so much from personal as from public considerations. I am anxious and ambitious that my native country should have the honor of being the first to introduce an improvement of such immense importance to society at large, and should feel the utmost reluctance at being compelled to resort to foreigners in the first instance. As no doubt exists in my mind but that the value of the improvement would be duly appreciated and carried into immediate effect by transatlantic governments, I have been the more urgent in pressing the subject on the attention of Congress. Whatever then may be its fate, should this appeal be considered obtrusive and unimportant, or, from whatever other cause or motive, should it be suffered to remain unheeded, I still have the consolation of having performed what I conceive to be a public duty."

CHARTER FOR THE PENNSYLVANIA RAILROAD GRANTED IN 1823.

Failing to secure favorable consideration from Congress, he probably increased his efforts to secure a railway charter from the state government of New Jersey, authorizing a road from Trenton to New Brunswick. At all events, his efforts to obtain such a charter were successful in 1815. But he seems to have been unable to speedily obtain a sufficient amount of capital to construct the proposed line, and his next step was to construct a short experimental railway, at his own expense, at Hoboken in 1820. In 1818 or 1819 he addressed a memorial to the legislature of Pennsylvania, recommending the construction of a railway from Philadelphia to Pittsburgh, and in 1823 he secured, in conjunction with other corporators, who were citizens of Pennsylvania, the passage of an act by the Pennsylvania legislature authorizing the construction of a line from Philadelphia to Columbia.

The law was approved on March 31st, 1823. It is entitled an act to incorporate a company to erect a railroad from Philadelphia to Columbia, in Lancaster county, the terminal points being those between which the first important turnpike in the United States was constructed. The proposed title of the corporation to be created was, "The President, Directors, and Company of the Pennsylvania Railroad Company." The preamble is as follows: "Whereas, it hath been represented by John Stevens, in his memorial to the Legislature, that a railroad from Philadelphia to Columbia would greatly facilitate the transport between those two places, suggesting also that he hath made important improvements in the construction of railways; and praying that in order to carry such beneficial purposes into effect, himself and his associates may be incorporated." The corporators were John Connelly, Michael Baker, Horace Binney, Stephen Girard, Samuel Humphreys, of Philadelphia; Emmor Bradley, of Chester county; Amos Ellmaker, of Lancaster city; John Barber and William Wright, of Columbia."

The section relating to the charges authorized was as follows: "That on the completion of the said railroad, all transportation on the same, of whatsoever nature or kind, shall be carried on and conducted by and under the superintendence and direction of the said John Stevens, or of his legal representative or representatives; and it shall and may be lawful for said John Stevens and his legal representative or representatives to charge and receive for freight, on and for the transportation of goods, wares, and merchandise, at a rate not exceeding seven cents per mile on each and every ton thereof passing westward, and three and a half cents per mile on each and every ton weight thereof passing eastward on the said railroad; but on all single and detached articles, weighing less than a ton, it shall and may be lawful to charge and receive, on the transport of the same, an advance not exceeding twenty per cent. on the rates as above established."

The financial scheme contemplated by this charter was novel. Subscriptions of stock were to be invited in the usual manner; but the total number was not to exceed six thousand shares of one hundred dollars each, so that it was probably supposed at that time that this primitive railroad might be constructed on a line now occupied by one of the most expensive and profitable lines in the United States at a cost of about eight thousand dollars per mile. As it was uncertain whether the cost would exceed the sum derived from share subscriptions, or fall below it, the charter contained a section relating to the capital of the company, which was as follows: "That on the completion of said railroad the president and directors are hereby required to ascertain precisely the amount of the sum total of expenses incurred in the construction of the same, and said sum total shall constitute the existing capital of said railroad company." Another strange feature of this charter was a provision which, perhaps on account of a supposition that Stevens should possess special rights in the new enterprise analogous to those enjoyed by a patentee, declared that after dividends on amount of capital stock, amounting to three per cent. quarterly, or twelve per cent. per annum, were paid to the stockholders, all profits exceeding that liberal return should be retained by the said John Stevens or his legal representative or representatives. If the company did not earn more than twelve per cent. per annum on cost of road, and thus provide an excess out of which Stevens was to be paid for his labors, the charter provided that "in every such case the said John Stevens, or his legal representative or representatives, shall be paid such compensation for his or their services, during each year, as may be agreed upon by the said John Stevens, or his legal representative, and the said president, directors, and company of the said railroad company."

This charter led to no immediate practical results, and the charter was repealed in 1826. But little was known at that time of railway operations, and the difficulties of procuring the requisite capital under the plan proposed were insurmountable. The stipulations mentioned above, however, throw an interesting light upon the ideas prevailing in regard to railways in the most advanced circles in 1823.

EARNEST BUT UNSUCCESSFUL ADVOCACY OF THE FIRST PROPOSED PENNSYLVANIA RAILROAD.

The failure was due mainly to the lack of confidence among capitalists, which has postponed the completion or prevented the construction of many other lines proposed at later dates. An evidence of the persistence and ability with which Colonel Stevens advocated this project is furnished by the following public letter, published in 1823, which was doubtless one of the agencies that gradually prepared the public mind for the effective support of railway schemes:—

"PHILADELPHIA, 1823.

"SIR: It is now generally admitted that a railroad is not a mere visionary project, but is actually practicable. An erroneous idea has, however, prevailed among its opponents, that it is only practicable to short distances, and that the contemplated extension of a railroad to a distance of 73 miles is ridiculous.

As the railroad will, throughout its course, be, in its construction, exactly similar, it is only in its deviations from a horizontal line that any difference in the progressive motion of carriages thereon can take place. The charter contains a provision that the railroad in its progress shall in no part rise above an angle of two degrees with the plane of the horizon.

Now let us suppose that a section of the intended railroad be constructed in the immediate vicinity of the city, of one mile in extent, in the progress of which elevations of two degrees do actually occur. Should it, however, be practicable, on such section of the intended railroad, to cause loaded carriages to move forward and backward, without encountering any impediment or difficulty, would it not be presumable that the effect would be precisely the same were a similar road to be extended ever so far? Such an experiment, then, would not fail to produce conviction in the minds of the most incredulous.

As a further illustration of the practicability of the proposed railroad, it would be barely necessary to notice the rapid progress this important improvement has recently made in the island of Great Britain. If, in the narrow limits of 21 miles in length and 12 miles in breadth, in the immediate vicinity of Newcastle, no less than 450 miles of railroad have, within a very short period of time, been formed, why should it not be practicable to erect one extending only 73 miles? The contemplated formation of a railroad from Manchester to Liverpool, between which large towns there now exists a spacious canal, demonstrates very forcibly its feasibility and great utility.

The expense of the contemplated railroad is estimated at about $5,000 per mile. One thousand shares, then, at five dollars each, would be sufficient for the construction of one mile of the road.

An appeal is now, therefore, made to the enlightened patriotism and to the enterprising spirit of the good citizens of Philadelphia to step forward, and, by an advance of five dollars each, to place the contemplated improvement beyond all possibility of doubt or uncertainty.

That the stock will, from the start, yield more than legal interest, there cannot be a shadow of a doubt, That it will, ultimately, and at no distant period, yield 12 per cent. per annum, is equally certain.

The contemplated railroad will differ from turnpike roads in these very important particulars: The actual expense of transportation on the railroad will be reduced to one-quarter of what it now is on the existing turnpikes. But the most essential point of difference, as it regards stockholders, is, that the whole of the emoluments to be derived from the transportation of commodities, and from the conveyance of passengers, will go to the railroad company, whereas the turnpike company receives only a toll. The expense of repairs will bear no proportion to that incurred on turnpike roads. The railroad too will be equally good at all seasons of the year. This circumstance gives to a railroad a decided superiority also over a canal, which continues, for months, during the winter season, locked up by frost.

But when, in the progress of improvement, the power of steam shall be substituted for that of horses, transportation will most assuredly be afforded at much less than on a canal. However extraordinary this opinion may appear, by a recurrence to calculation, it is, nevertheless, capable of demonstrative proof. And when this great improvement in transportation shall have been extended to Pittsburgh, and thence into the heart of the extensive and fertile state of Ohio, and also to the great western lakes, Philadelphia may then become the grand emporium of the western country.

Should the subscription for the shares be speedily filled the road from Philadelphia to Columbia may with ease be finished before the next winter, and thus the stockholders will derive an immediate interest on their stock.

I am, sir, your obedient servant,

JOHN STEVENS."

One of the passages of this public letter shows that in addition to advocacy of lengthy through railway lines extending in New York from the Hudson to lake Erie and in Pennsylvania from Philadelphia to Pittsburgh, Colonel Stevens also recommended that railway companies should furnish cars and motive power. He was the inventor or constructor of the successful steamboats which entered into rivalry with those made by Robert Fulton.

ROBERT FULTON'S PROPHECY.

It is a curious fact that Mr. Fulton had also reached the conclusion that railways could be made advantageous avenues of lengthy transportation movements at a very early period. It is reported that when he was journeying over the Allegheny mountains, in a stage coach, to Pittsburgh, in 1811, he said:—

"The day will come, gentlemen, I may not live to see it, though some of you who are younger will probably—when carriages will be drawn over these mountains by steam engines, at a rate more rapid than that of a stage on the smoothest turnpike."

The fact that the earliest serious advocates of railways in the United States had been extensively engaged in steamboat or steam engine operations is suggestive. It indicates a logical connection between schemes for conducting transportation by steam, in steamboats, on water, and on railways with the aid of locomotives; shows that the early American railway advocates possessed superior ability; and also foreshadows such transitions of prominent and active men from one of these fields of activity to the other, as have occurred.

COLLIERY AND QUARRY RAILROADS.

WHILE the three men who above all others best represented the inventive and practical talent of the United States applicable to transportation, during the early decades of the nineteenth century, viz., Oliver Evans, John Stevens, and Robert Fulton, adopted advanced views, their dissemination was a slow process, and actual demonstration of the superior utility of crude railroads or tramways, on which horse power was used, as avenues for moving freight and passengers, was probably the most powerful agent in educating the public mind, and securing the assistance of capitalists for railways.

The advantages of primitive railroads or tramways began to elicit a limited amount of discussion among the members of American societies engaged in promoting internal improvements about the beginning of the nineteenth century. At that time colliery roads, over which vehicles were moved on rails, had been operated for more than a century and a half in Great Britain. Considerable improvements in the mode of their construction had been commenced, and were still progressing. The state of English tramway development, as it then existed, and as it may have been known to intelligent American students of such subjects, is typified by the fact that the Register of Arts, a work published in Philadelphia in 1808, contains several articles on iron railways (or tramways), one of which describes the Penrhyn Railway, a line six miles and a quarter in length, divided into five stages, built mainly for the purpose of hauling slate. It is stated that on this railway "two horses will draw twenty-four wagons one stage six times a day, and carry 24 tons each journey, which is 144 tons per day. This quantity used to employ 144 carts and 400 horses; so that the 10 horses will, by means of this railway, do the work of 400." Illustrations are published of the cars used and of the rail.

Another article in the same publication is on the utility of iron railways, and describes the result of a series of experiments, made on August 14th, 1799, at a colliery at Measham, in Derbyshire, England, "for the purpose of obtaining ocular and satisfactory proof of the utility of iron railways." It says "the result of the experiments was nearly thus: One horse, of the value of £20, on a declivity of an iron road five-sixteenths of an inch in a yard, drew twenty-one carriages or wagons, laden with coals and timber, amounting, in the whole, to thirty-five tons, overcoming the *vis inertia* repeatedly, with great ease. The same horse, up this acclivity, drew five tons with ease; he also drew up the road, where the acclivity was 1¾ of an inch in a yard, three tons."

Similar performances at another adjacent colliery are reported, and it is stated that on the road on which they occurred, "the rails are three feet long each, 33 pounds weight, and calculated to carry two tons on each wagon, laid four feet two inches wide, on stone or wood sleepers, placed on a bed of sleck, so as to fix it solid and firm. The expense of completing one mile of such a road, where materials of all descriptions lie convenient, and where the land lies tolerably favorable for the descent, will be £900 or £1,000 per mile, single road, fenced, &c., exclusive of bridges, culverts, or any extra expense in deep cutting or high embankments. Rails are made from twenty to forty pounds per yard, agreeable to the weight they have to bear."

GRADUAL IMPROVEMENT OF THE PRIMITIVE ENGLISH RAILROADS.

Smiles' Life of George Stephenson states that in 1630 Master Beaumont laid down *wooden* rails from his coal pits, near Newcastle, to the river side. In 1738 iron rails were first laid down at Whitehaven. In 1789 Jessop introduced at Loughborough the cast-iron edge rails, and flanches cast upon the tires of the wheels, so as to keep them in the track. In 1800, at Little Eton, Derbyshire, Outram used stone sleepers. From his name is derived the term "tramways." In 1802 Trevethick invented and patented his railway locomotive. In 1812 Blenkinsop's engine worked at Leeds, drawing 33 coal wagons at the rate of three and three-quarter miles per hour. In 1815 George Stephenson constructed his locomotive, and in 1816 he invented a new rail and chair. On September 27th, 1825, the railway from Stockton to Darlington was opened for traffic.

An interesting condensed statement of the gradual development of tramways in England is furnished in the following abstract of a paper read before a meeting of the Amalgamated Society of Railway Servants of Great Britain, in which Mr. Clement E. Stretton, C. E., an honorary member, traced the growth of British railways from 1630 to 1830: "About the former year a Mr. Beaumont took the lead in a movement to facilitate the conveyance of coal from the mines to the points of shipment by means of wooden ways, consisting of cross sleepers placed about two feet apart, upon which were nailed wooden planks or rails six feet long and about four inches wide. This pioneer of progress also introduced four-wheel wagons to run on the wooden ways, instead of the ordinary two-wheel carts. Like most men, however, who attempted to make innovations on British methods, Beaumont lost his fortune in the attempt, and emerged from his reforming schemes reduced to poverty. Although the inventor of wooden ways obtained only loss and annoyance from his improvement of transportation facilities, his invention outlived him, and was improved by being covered with sheet iron, to prevent the attrition caused by the iron-shod wheels. This was 'plating' the rails, from which the word platelayer comes, the appellation still borne by all trackmen in Britain. The transition from plated wooden rails to rails made of cast iron was easy and natural where iron working was developing. The rails for 150 years after this form of track was first tried were flanged, so as to keep a vehicle with plain wheels on the track.

One of the greatest improvements was introduced, 1789, by Mr. William Jessop, when constructing a railroad at Loughborough, in Leicestershire. This engineer decided to abandon the flat wheels and flanged rails, and to introduce iron rails with flat top, and wheels with a flange cast upon the tire. Mr. Jessop's rail was known as the 'edge rail,' because the wheels ran upon the upper edge. These rails were of cast iron, 3 feet long, having a single head 1¾ inches wide. They were of the 'fish-belly' pattern, that is, deeper in the centre than at the ends, it being considered that it combined the greatest strength with the least expenditure of material. They were fastened to cross sleepers by iron pins or bolts passing through a projecting base at the ends of the rails. It was soon found that the cast-iron projections were broken off, and the rails rendered useless, as there was then no way of fastening them. This led to a great and important improvement. The base was removed from the rail itself, and cast as a separate 'chair or pedestal.' The plan of bolting the chair to the sleeper, and fastening the rail by means of a key driven between it and the chair, is in use in England to this day.

The long wrought-iron rail was first introduced about the beginning of this century, and gradually pushed out its cast-iron predecessor.

The usual width of the old wooden and cast-iron tramroads practically determined the gauge of our present railways. The usual width or gauge of these old tramroads was *five feet* over all, that is, including the width of the two rails, and, as Jessop's edge rails and the Killingworth tramroad had rails 1¾ inches wide, the width of two such rails deducted from 5 feet leaves 4 feet 8½ inches between the rails, or what we now consider the national gauge. George Stephenson saw no reason to alter the gauge. Therefore, he adopted 4 feet 8½ inches for the Stockton and Darlington, and Liverpool and Manchester railways, and, when consulted as to the gauge for the Leicester and Swannington, and the Canterbury and Whitestable railways, he replied: 'Make them of the same width. Though they may be a long way apart now, depend upon it they will be joined together some day.' The 'fish-belly' rails, fifteen feet long, were adopted for all these lines."

IMPORTANCE OF THE EDGE RAIL.

Of the advance made by Jessop, 1789, by which flanged wheels were substituted for flanged rails, a distinguished English engineer forcibly says that it "was an organic change which has been the forerunner of the great results accomplished in modern traveling by traveling by railway. You may easily imagine the condition to which our railways would be reduced if they were constructed on the principle of street tramways; how they would be obstructed by slight impediments, and how difficult the construction of junctions would be rendered, by considering how the speed and convenience of railway traveling would have been retarded if it had not early been discovered that the rail should be lifted clear of the ground, and the guide put upon the wheel instead of the rail."

THREE GREAT RAILWAY INVENTIONS.

It is a remarkable fact that previous to this time no one seems to have seriously thought of using railways for miscellaneous traffic. The locomotive or steam wagon had received consideration, and steam had even been experimentally applied to land transportation at low rates of speed, but the drift of inventive effort continued to be towards steam wagons or vehicles adapted to common road or turnpike movements until some years after the edge rail and flanged wheel had been devised. It would be difficult to designate any three general ideas which, above all others, helped to promote railway construction, to a greater extent than this Jessop edge rail, Oliver Evans' high-pressure locomotive, and George Stephenson's favorite doctrine that the railway and locomotive should be inseparably wedded, like man and wife.

In view of the relative antiquity of crude colliery and quarry railroads in England, it is rather surprising that the construction of similar lines, even for short distances, does not seem to have been attempted anywhere in the United States until near the close of the first decade of the nineteenth century.

THE FIRST AMERICAN RAILROAD

was probably a short one built by Silas Whitney on Beacon Hill, Boston, in 1807. It is claimed, however, that this was preceded in the same locality by an incline plane used to draw bricks in 1795, which had as part of its appliances a wooden tramway, of about two feet gauge, on which loaded cars were forwarded to the foot of Beacon street, while empty cars were drawn to kilns at the top of Beacon Hill.

At one time it was believed that the first of such lines was constructed by Thomas Lieper, in Delaware county, Pennsylvania, which it was alleged was finished in 1806. But it seems to have been erroneously antedated, and a controversy relating to this subject resulted in the publication of the following statements: A millwright from Scotland, named Somerville, who had seen tramways in his native land, was employed by Mr. Thomas Lieper to lay a track sixty yards in length, at a grade of one inch and a half to the yard, and this experimental track was laid down at the Bull's Head tavern in Philadelphia, in September, 1809. A memorandum book of Mr. Lieper's shows that in May, 1809, he made estimates of the cost of a line from his quarries, and in January or February, 1810, Mr. Lieper estimated that a railroad three-fourths of a mile long, leading from his quarries to the landing place on Crum creek, had cost, including the survey, \$1,592$\frac{47}{100}$. It had then been completed under the direction of Mr. John Thomson, father of J. Edgar Thomson, who subsequently became president of the Pennsylvania Railroad Company. A minute of the proceedings of a meeting of the Delaware County Institute of Science, held on February 1st, 1873, embraced the following: "Mr. John M. Broomall read Dr. Joshua Ash's answer to the question, 'when and where was the first railroad built in the United States?' It gave credit to the road built by Thomas Lieper to move stone from his quarries in Nether Providence (not Ridley), and built October, 1809, as shown by the original draft made by John Thomson. The original map was presented to the institute by Dr. Ash, who procured it from J. Edgar Thomson, president of the Pennsylvania Railroad Company, son of the draughtsman."

The third railroad or tramroad in the United States was probably one constructed on Falling's creek, Chesterfield county, Virginia, about ten miles from Richmond, soon after 1810, to furnish transportation facilities for a powder mill. Of this work Mr. Thomas A. McKibben, of Baltimore, in a letter to the Chicago American Engineer, dated July 1st, 1886, says that it was devised by George Magers, and that "it was about a mile long, and run between the magazine and the mill. It was down a grade to the magazine, and I estimate from my uncle's remarks that the gradient was about 8 feet in 100. Cross ties or floor joists were laid, and the rails, of hard wood, were laid about an ordinary wagon gauge. One rail was grooved, and the other tongued. The rails were cut out of the solid timber, and between them a flooring, securely fastened to the cross ties, was laid the entire length of the road. The country was very hilly, and at one point on its length it passed over a valley about a quarter of a mile wide. Across this valley the inventor erected an immense trestle some 75 feet high. My uncle says it was an immense piece of work, securely braced in every conceivable way. The wagon that ran upon it was very large, 18 or 20 feet long in the body, running upon low wooden wheels about two feet in diameter, composed of double plank of hard wood, cross-grained to each other, and securely fastened. The wheels one side were tongued, and the others grooved, to suit their respective rails, and there was a lever or brake to control the speed down to the magazine. When the car was unloaded it was hauled up again by a stout rope winding on to a huge vertical drum, operated by the water-wheels at the mill. My uncle has no recollection of how they signaled to the mill for the return trip, or whether they run the car on time.

Mr. George Magers died in Chesterfield county, and was buried in a church-yard, near the court house, in 1818. My uncle returned to Baltimore in 1823, and at that time the railway was still in use, but only as a curiosity, as the mill blew up in 1819. The railway was not affected by the 'blow up,' and the people around the country used to visit it, the hands living in the neighborhood operating it for their own amusement making excursions on the road."

The fourth tramway is said to have been built at Bear Creek Furnace, Armstrong county, Pa., in 1818. Its tracks consisted of wooden rails. The fifth was probably one laid in Nashua, N. H., in 1825, and the sixth, the Quincy Railway, in Massachusetts, about four miles in length, built in 1826, to haul granite to the port of Neposit.

The construction of the

QUINCY RAILROAD

was suggested and superintended by Gridley Bryant, who was a builder and contractor of Boston, and the owner of the quarry containing the stone he desired to remove to tidewater by the railway, which stone was to be used in the Bunker Hill Monument. Chiefly on account of interest in that patriotic undertaking, the means for constructing the road were advanced by Colonel T. H. Perkins. The plan adopted was to lay stone sleepers across the track eight feet apart, upon which wooden rails, six inches thick and twelve inches high, were placed. On the top of these wooden rails, iron plates three inches wide and one-fourth of an inch thick, were fastened with spikes. At crossings of public roads stone rails were used instead of wood, on the top of which large iron plates firmly bolted to the stone were placed. It is said that the road continued to serve the contemplated purpose for more than a quarter of a century with very slight expenditures for repairs.

KNOWLEDGE OF RAILWAYS IN 1825.

LABORS OF THE PENNSYLVANIA SOCIETY FOR THE PROMOTION OF INTERNAL IMPROVEMENTS.

THE earnest advocacy of railways by such men as Oliver Evans and John Stevens, the success of primitive railroad or tramway experiments in several places, the growing interest in railway improvements that was manifested in England, and the general progress of this country, created a strong desire in some influential and important circles to obtain more definite knowledge than had previously been available of the exact nature of the English railways. One of the outgrowths of this state of affairs was the organization in Philadelphia, in December, 1824, of the "Pennsylvania Society for the Promotion of Internal Improvements in the Commonwealth." At the outset it contained forty-eight members, each of whom subscribed one hundred dollars, to form a fund for the immediate promotion of the object in view, and the further sum of ten dollars annually. Efforts were speedily commenced to expand the sphere of its operations by increasing the number of members, and obtaining assistance from numerous friends of internal improvement, which were successful. Early in 1825 the society resolved to send William Strickland, Esq., to Europe to collect information relating to valuable improvements in the construction of canals, roads, railways, bridges, steam engines, and various industrial arts. The instructions to Mr. Strickland, explanatory of the views and wishes of the society, are dated March 18th, 1825. They are signed by the following members of the acting committee: Matthew Carey, Richard Peters, jr., Joseph Hemphill, and Stephen Duncan. They are somewhat lengthy and elaborate, entering minutely into details, but their general scope, aside from references to investigations of methods for making coke and iron, which he was directed to institute, is indicated by the following extract:—

"It is not a knowledge of abstract principles, nor an indefinite and general account of their application to the great works of Europe, we desire to possess through your labors. . . What we earnestly wish to obtain, is the means of executing all those works in the best manner, and with the greatest economy and certainty; and for these purposes you will procure and exhibit in your reports, all that will enable those who shall undertake the formation of canals, railways, and roads, and the construction of bridges, to perform the work, without such persons having the science by which such works were originally planned and executed. To use a term which is familiar to you as an architect, we desire to obtain working plans of the best constructed canals, and their locks and inclined planes; of railways, and all means of using them to advantage; of roads and of the mode of their formation and preservation; and of the construction of bridges. To be more definite on this head, we desire that you furnish such minute and particular descriptions, plans, drawings, sections, estimates, and directions, as, possessed of them, that these works may be executed in Pennsylvania, without the superintendence of a civil engineer of superior skill and science." The instructions also requested that his first efforts should be directed to railways.

The amount of knowledge possessed in 1825 in the most enlightened circles in the United States in regard to railways is indicated by the specific instructions relating to them, from which we extract the following: "Of the utility of railways, and their importance as a means of transporting large burdens, we have full knowledge. Of the mode of constructing them, and of their cost, nothing is known with certainty. . . You will bear in mind in your investigations of this subject that we have, as yet, no complete railway in Pennsylvania; and you will, therefore, so exhibit your facts, as that they may be understood by reference to the drawings which you may make, and which shall accompany your report.

Commencing in your examinations with the plans observed in making surveys and forming the line of the route of the railway, it is desired that you ascertain with precision the greatest angles of ascent (grades) which the profitable use of railways will bear. In our mountainous state, if railways shall be adopted, they must pass over numerous elevations, some of them abrupt, and many of them so formed as to render their reduction impossible.

The foundations for the reception of the iron rail will next require your attention. Climate must enter materially into the decision upon the question how the foundation of a railway shall be made in Pennsylvania; and the differences between the moist and moderate winters of England, and the deep snows, sudden and hard frosts, variable temperature, and long continuance of our winters, must have your consideration, and attention in these examinations. Without entering into the subject particularly, but submitting it, with great deference, to your consideration, we would remark that if masonry could be avoided in the construction of the foundation for the iron rails; if wood, however large in size, and great in quantity can be employed here, the influence of our climate upon the work would be less injurious. . . In relation to the construction and form of the road and rails, we desire you to ascertain every mode which is now in favorable use in England, Scotland, and Wales. It is said that recent improvements have been made in the form and position of the rails; and that different forms are used for different purposes. How railways are crossed by wagons heavily laden, how wagons pass when proceeding in opposite directions, what means are taken for the protection of railways from injury by wheels not properly constructed to pass upon them, and how their wagons and their carriages are constructed, and of what materials? Upon all these subjects we ask particular information, accompanied with drawings which will make the same easily understood and employed.

The expense of railways will be a subject of careful and particular investigation. In your statements under this head you will inform us of the separate cost of each part, distinguishing accurately between the charges for the formation of the line and the preparation of the foundation, and the expense of the materials employed.

Locomotive machinery will command your attention and inquiry. *This is entirely unknown in the United States*, and we authorize you to procure a model of the most approved locomotive machine, at the expense of the society."

MR. STRICKLAND'S REPORT.

Mr. Strickland continued to make reports from time to time, his first report on railways and locomotive engines being dated June 16th, 1825. He also obtained a model of an English locomotive of that period, which he brought or forwarded to this country, and which presumably embodied the first accurate and detailed representation of that important device that had ever been exhibited in the United States. It has long been one of the standard curiosities of the Franklin Institute. While he was abroad the controversy in regard to the relative merits of railways and canals, which continued for a number of years to form a pivotal feature of American transportation struggles and efforts, was attracting an increasing degree of attention. This fact led the society to address a letter to Mr. Strickland, on September 19th, 1825, which contains the following extract:—

"*Canals* and *railways* present the most important of all subjects for your attention. Upon every matter connected with both you will be expected to be well informed; and if you shall have to decide between them you must be able to furnish the facts and circumstances by which the decision shall be produced. Much excitement prevails in this state upon the question whether railways are superior to canals, and the inquiries that are in progress in relation to them are in the hands of men of ingenuity and well disposed to the cause of internal improvement. It is, however, feared by many that the question between canals and railways will have an injurious influence in Pennsylvania, as it will divide the friends of the cause of improvement, and thus postpone, if not prevent, the commencement of the work. The importance of correct information in relation to them is thus greatly increased."

Mr. Strickland shortly afterward returned to Philadelphia, and in 1826 his "Reports," illustrated by large and handsome plates, was issued. The information furnished by this publication rendered useful service in connection with a number of improvements,. and especially canals. But a competent authority, Mr. W. Hasell Wilson, in his notes on internal improvements in Pennsylvania, says that "at that time railways were only beginning to attract attention for purposes of general traffic, and the information given in relation to them was neither full nor important."

RAILWAY PROGRESS FROM 1825 TO 1830.

THE last half of the third decade of the nineteenth century was an eventful period. It formed an era during which sufficient changes in the prevailing sentiment were effected to make 1830 a vigorous starting point in railway improvements in several sections of the country. Up to 1825 all actual work had been confined to a few crude railroads. Shortly after the publication of Mr. Strickland's reports, the line of the Mauch Chunk Railroad was built for the purpose of carrying anthracite coal, and when it was finished, in 1827, it formed the longest and most important work of the kind then existing in the United States. Other railway or tramway lines were built soon after or about the same time, for similar purposes, the leading object being to furnish cheap transportation between coal mines located on elevated mountain regions, and adjacent canals built on the lower level which corresponded with that of the rivers from which water supplies were drawn.

These works required inclined planes, on which rails were laid, and a contrivance of that kind was used by the Lehigh Coal and Navigation Company at the early period of 1820. Inclined planes formed a very important feature of all railway projects intended to provide routes for mountainous districts, and the extent to which they should be substituted for heavy grades continued to be a debateable question for a lengthy period. The original inclined plane at Mauch Chunk may, therefore, perhaps be considered as an important adjunct or forerunner of the early railways. A short railway was built about 1827 in Schuylkill county to provide a connection between coal mines and the Schuylkill Canal. And on the railway connecting coal mines of north-eastern Pennsylvania with the Delaware and Hudson Canal, in 1829, the first American work of a genuine locomotive, imported from England, was performed.

There were other contemporaneous events of considerable significance, three of the most important of which were the passage of an act by the Pennsylvania legislature, in 1828, which provided for the construction of a railway, by the state of Pennsylvania, to extend from Philadelphia through the city of Lancaster, to Columbia, and thence to York; the incorporation of the Baltimore and Ohio Railway, to extend from Baltimore to some eligible point on the Ohio river, by Maryland and other states, in 1827 and 1828; and the incorporation of the Charleston and Hamburg Railway, in South Carolina, in 1827.

SHORT RAILWAYS AS FEEDERS OF CANALS.

The completion of the first important railway in this country and the first use of the locomotive, were the result of labors of canal companies, or of parties who wished to reach their lines, and this fact may have had a bearing on the protracted discussion relating to the rival merits of railways and canals as channels of communication over a given route. It has already been shown that the proposition of John Stevens to construct a railway instead of a canal as a main artery between eastern and western New York was ignored by the New York commissioners in 1811. And although he recommended the construction of a railway between Philadelphia and Pittsburgh to the legislature of Pennsylvania before 1820, that body, in its subsequent action in deciding upon a main line of public improvements between those cities, does not seem to have deemed railways worthy of serious consideration, except for the parts of the route proposed on which canal construction would have been unusually difficult and expensive, which were the regions between Philadelphia and Columbia, and the acclivities of the Allegheny mountains. To secure even this concession in favor of railways was difficult. Canals had been tested and rendered profitable in some localities, and the Erie Canal, of New York, promised to be a magnificent success. Whatever might be said of railways theoretically there was little or no positive knowledge in regard to their utility as avenues for miscellaneous traffic. Indeed their sturdiest advocates scarcely ventured to recommend them except for rapid passenger movements, and for the transportation of light and costly descriptions of freight that could afford to pay high charges to ensure rapid movement. A stage had been reached in which it was acknowledged by advanced thinkers that there were some routes over which railways could be profitably constructed, but it was for a protracted period difficult to secure means to build new lines that were not intended to be used mainly as substitutes for the portages, or connecting links between water courses, of primitive Indian and colonial overland movements.

The Baltimore and Ohio, however, was designed as a rival of the Chesapeake and Ohio Canal at the outset. They both became urgent applicants for state aid from Maryland, and an animated struggle was prosecuted between those corporations, which embraced lengthy discussions of the merits of the relative methods. A strong point in favor of railways, which was probably of sufficient importance to determine doubtful contests in their favor, was the success of the first two English lines used for general traffic, the Stockton and Darlington, opened in 1825, and the Liverpool and Manchester, opened in 1829.

Neither the Mauch Chunk, Schuylkill, or Delaware and Hudson lines could have been expected to give much of an impetus to railways intended for miscellaneous public uses. They were mere adjuncts of canals intended mainly for the movement of coal. It was natural that the first railway work of considerable consequence should be commenced for this purpose, and perhaps equally natural that none of the pioneer coal railways were lengthy, inasmuch as the belief then was nearly universal that cheap transportation could only be secured on natural or artificial water routes, and the main cost of coal at the place of consumption is made up of charges for moving it. Of the

FIRST RAILWAY IN THE SCHUYLKILL REGION,

Coal and Iron and Oil says: "It was not until 1827 that rails were used in the (Schuylkill) mines, and up to 1829 the coal was carted over common mud roads from the mines to the canal. Abraham Pott, of Port Carbon, was the first to build a model railroad in the Schuylkill region. It led from his mines to the canal, a distance of half a mile. Soon after the Mill Creek Railroad was built from Port Carbon to the Broad Mountain, about the present town of St. Clair. The distance is about three miles. The cost was $3,000. This was in 1829."

A historical sketch of Pottsville states that in 1825 the Schuylkill Canal was opened to Mt. Carbon, then a suburb of Pottsville, and in 1826 and 1827 Abraham Pott built a railroad extending half a mile in length near Pottsville. The railway was made of wooden rails, laid on wooden sills, and was successfully operated in carrying coal, which, previous to that time, was hauled in wagons to the canal, and thence sent to market. In 1829 the directors of the Schuylkill Canal came to Pottsville, and viewed this primitive road in operation. They were taken by surprise when they saw thirteen railroad cars loaded with 1½ tons each, and they were shocked when Mr. Pott, the projector of this corduroy railroad, told them that in less than ten years a railroad would be in operation along the line of their canal. After events proved that he was right in everything except as to time, for it was not until 1842 that the first train passed over the extension of the Philadelphia and Reading Railroad from Mt. Carbon.

The Pottsville Board of Trade, in replying in 1834 to inquiries of a committee of the legislature of Pennsylvania relating to coal, said: "Previous to the erection of any of the public railroads our enterprising fellow-citizen, Abraham Pott, constructed a railroad from his mines, east of Port Carbon, to that place, making a half mile. This served as a model, and may be termed the beginning from which all originated."

THE MAUCH CHUNK RAILWAY.

Professor Silliman, in Notes of a Journey to Mauch Chunk, published in 1830, in referring to the Mauch Chunk Railway, says that Mr. Josiah White, then the leading spirit of the company which had constructed this pioneer line, "states, in a public document, that their railway alone had saved them $50,000, but that he does not think it economical, on account of the wear and tear, to travel over railways faster than six miles an hour with heavy loads, unless with passengers and valuable goods, which will bear heavy tolls, so as to reimburse the expense of repairs, which is of course greater as the motion is more rapid. Still, he is of opinion that a railroad may be constructed sufficiently solid, strong, and true to admit of a motion of sixty miles an hour for a short time."

Professor Silliman says the Mauch Chunk Railroad was built in three months after the wood used in its construction was growing in the forest. A Baltimore and Ohio committee, which inspected it, thought it a very simple affair.

Mr. Josiah White formed such an unfavorable opinion of railways, on account of the necessity for frequent and expensive repairs, which was developed on the short line he had constructed, and the high cost of movement as compared with canals, that he continued to be a firm advocate of the latter class of improvements, and insisted upon the reconstruction of the canal after it had been nearly destroyed by a freshet, at a time when the substitution of a railway would have been advisable.

THE DELAWARE AND HUDSON RAILWAY.

Of the very early coal railways in Pennsylvania the longest and most important was that constructed by the Delaware and Hudson Canal Company. A statement published in 1829, by Jacob S. Davis, says: "The Lackawaxen Canal, constructed by the Delaware and Hudson Canal Company, extends from Honesdale down by the eastern and northern side of the Lackawaxen river to its mouth, descending 371 feet by 37 locks. The Delaware and Hudson Canal is connected with its lower extremity, and extends down the eastern side of the Delaware river to Carpenter's Point, and thence to Kingston on the Hudson river. The Lackawaxen Canal is 20 feet wide at bottom, 32 feet at top, and 6 feet deep. The boats that navigate the canal, are 70 feet long, 8 feet 7 to 8 inches wide, and carry 25 tons. From Honesdale a railroad extends up the valley of the west branch of the Lackawaxen; and crossing the river near the mouth of Vanauken brook, it continues in a western direction through Canaan township, and across the Moosic mountain at Rig's Gap to Carbondale, being 16 miles in length; overcoming an elevation and descent of 1,812 feet, by 8 inclined planes, one of which is near the mouth of Vanauken—two on the eastern and five on the western side of the mountain. At the head of last inclined plane is erected a building containing a stationary steam engine, for the purpose of assisting the wagons in the ascent and descent."

George W. Smith, writing in June, 1828, says: "The company have excavated a canal from the Hudson to the Delaware, in the state of New York. Thence the route of 29 miles, up the Lackawaxen to the forks of Dyberry, is in Pennsylvania. At this place the canal terminates, at a distance of 105 miles from the Hudson, and 33 from the Great Bend, on the Susquehanna. It is in contemplation to form a connection between these points by a railway, to be constructed by another company not yet incorporated.

From the forks of the Dyberry to Carbondale, a distance of 15 miles nearly, a railway is being constructed with timber rails, guarded by iron bars, and resting on stone supports. It is calculated for the employment of horse power and locomotive engines on the more level portions, and for stationary steam engines on the inclined planes. The estimate for these 15 miles of railway, including all the machinery, is $178,228 (the greater portion of which has been expended), a sum sufficient to defray the cost of only seven miles of the canal which it was once intended to construct over part of the route."

It was on a portion of this railway, between some of the inclined planes mentioned, that

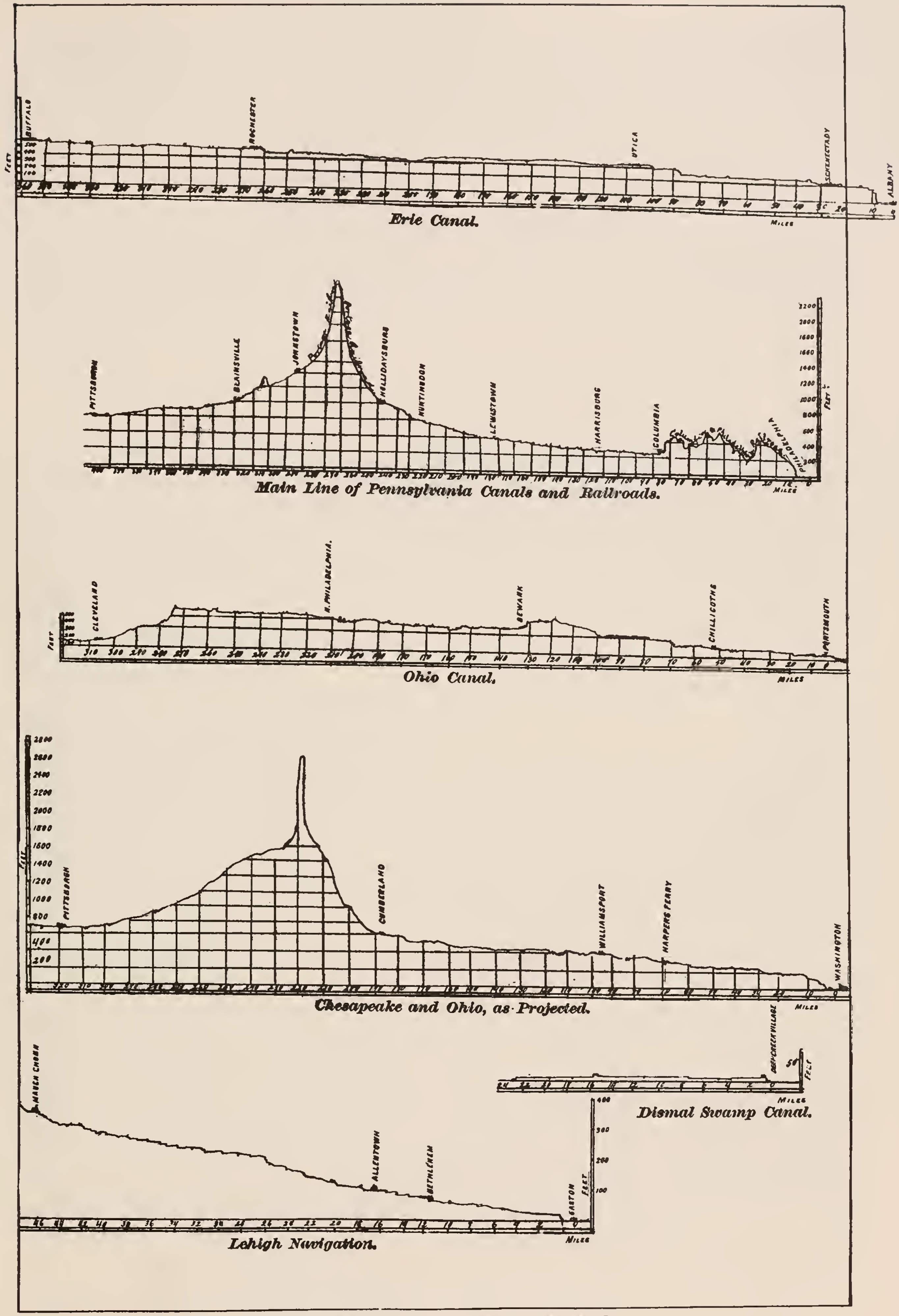
THE FIRST LOCOMOTIVE SERVICE

was performed in the United States or the western continent, and it is a notable fact that this experiment was so unsatisfactory, chiefly on account of the imperfect nature of the railroad, the excess of the weight of the engine over the weight prescribed in the order given for it, and the limited scope for locomotive performances on the short spaces between the inclined planes, that the pioneer of a mighty race of steam giants was speedily discarded as a thing of no real utility in the surroundings to which it was applied, after doing all that could reasonably be expected.

Of this locomotive experiment, a modern account says: "In 1828 John B. Jervis, chief engineer of the Delaware and Hudson Canal, sent his assistant, Horatio Allen, to England to investigate the application of steam to land transportation. Allen became convinced that Stephenson's ideas were destined to revolutionize commerce, and he, therefore, bought for the canal company three engines to be used on the initial railway in the United States. In May, 1829, the first of the engines was landed here; was put together by Allen, and exhibited at the foundry for some weeks. It was queer-looking enough, having four wheels connected by side rods. Vertical cylinders on each side of the rear end of the boiler communicated motion to a vast walking beam, attached to the side rods of the driving wheels by other long iron rods. The engine was, indeed, so covered with rods and joints that it resembled a vast grasshopper. Having been delivered at Honesdale in due season, on the 9th of August, 1829, Allen had it put on the track, consisting of hemlock stringers or rails, in section, 6×12 inches, on which bars of rolled iron, 2¼ inches wide, and one-half inch thick, were spiked. The hemlock rails were supported by caps of timber ten feet from centre to centre. The engine weighed seven instead of three tons, as had been agreed upon. The rails had been warped, and as the road crossed the Lackawaxen river, after a sharp curve, on a slender hemlock trestle, which, it was believed, would not support the engine, Allen was besought not to imperil his life on it. He knew there was danger, but, ambitious to connect his name with the first locomotive in America, he determined to take the risk. He ran the engine up and down along the coal dock for a few minutes, and then invited some one of the large assembly present to accompany him. Nobody accepted, and, pulling the throttle valve open, he said good-bye to the crowd, and dashed away from the village around the abrupt curve, and over the trembling trestle, amid deafening cheers, at the rate of ten miles an hour. The Stourbridge Lion, as the engine was named, was attached, after the trial, to trains of coal cars, and drew them satisfactorily on the docks; but it could not be employed to advantage on so slight a railway, which could not be fitted to the engine on account of the expense required. The Lion was, therefore, placed in a shanty on the docks, and stayed there for years. Finally it was taken to pieces, its boiler being carried to Carbondale, and put in a foundry, where it is still in use. The other two engines shared the same fate."

THE CHARLESTON AND HAMBURG OR SOUTH CAROLINA RAILWAY.

Mr. Horatio Allen, the hero of the first locomotive trip in America, had received the appointment of chief engineer of what was first known as the Charleston and Hamburg Railroad, and subsequently became the South Carolina Railroad, a short time before that trip was made, and he states that in September, 1829, he was at Charleston, South Carolina, to enter upon his new duties. The South Carolina Railway completed the construction of a portion of their line during the early years of the third decade of the nineteenth century, and preliminary or experimental operations had been commenced previous to 1830. A southern journal states that "the original charter of the company was obtained from the South Carolina legislature in 1827, books of subscription being opened in February of that year. The earliest projectors of the road were Alexander Black, Tristan Tupper, William Aiken, George Bennett, and others, who organized the company in May, 1828. In those days the railroad



PROFILES OF PROMINENT CANALS.

was a thing of the future, and the originators were met on every side with jeers and ridicule. They did not seem themselves to have any clear idea of the extent and scope of the project which they were undertaking, and the fear of ridicule made them pursue their plans in secret. In February, 1829, they made an experiment. They built one hundred and fifty feet of railway track, very crude it was, in Wentworth street, Charleston, and procured a four-wheeled car upon which they placed forty-seven bales of cotton. A mule was hitched to the car and drew the load with ease. This was a revelation. It developed the drawing capacities of the mule to an extent that had never been dreamt of before and inspired the conspirators with renewed confidence and hope. They began to entertain the idea of running a railroad between Charleston and Augusta with mule power, and saw 'millions in it.' Emboldened by this experiment, two months later one hundred and seventy feet of track was laid on Chisholm's wharf, and upon this the rails (flat iron) were transported from the ship. In June, 1829, a meeting of the stockholders was held and directors were authorized to begin work on the road between Charleston and Hamburg. At this time the company had received about five hundred tons of rails, and the legislature had advanced $100,000 in the way of a loan.

On the 1st of April, 1830, one mile of the South Carolina Railroad had been laid and the first train was started over it. The 'train' consisted of a cranky four-wheel car which carried thirteen persons and three tons of freight. It was propelled by means of a large square sail, which was rigged up on a mast and accomplished a speed of fifteen miles an hour."

Of the construction of interior portions of the South Carolina Railroad, the story is told that when a lot of wheelbarrows arrived in a district where they were to be used by slaves, they commenced operations by carrying the wheelbarrows on their heads.

RAILWAY CONSTRUCTION FROM 1830 TO 1840.

PREPARATIONS FOR RAILWAY ADVANCES.

WHILE the period between 1825 and 1830 was peculiarly important in movements which laid the groundwork for preparations for railway construction, it can scarcely be said that any railway intended for miscellaneous traffic was completed and in successful operation in the United States before 1830. That is, therefore, the year from which the growth of the American railway system is generally dated, and about that time, or a few years later, real or imaginary difficulties were sufficiently overcome to render railway projects of one kind or another a subject of serious consideration in nearly all the localities in which the growth of traffic, population, wealth, and intelligence, and the absence of adequate water routes gave to such schemes a rational hope of success.

The canal, stage-coach, turnpike, and steamboat were each and all well advanced in their essential features when the railway first appeared. It came as the rival and adjunct of facilities gradually developed up from low to high points by the slow but steady progress of centuries, and it came to stay, because all these antecedent appliances failed to satisfy the public requirements. Before the railway there was a long series of preparations. Turnpike, canal, and stage-coach companies had familiarized investors with the corporate combinations necessary to ensure railway success. Many advances had been made in mechanical progress, and notably in the improvement of the steam engine, which had been successfully applied to various purposes, and especially to transportation in steamboats and steamers. Carriages, coaches, and wagons had also been greatly improved, and turnpikes promoted the use of superior vehicles.

By 1830 many of the preliminary obstacles had been cleared away, and a number of the conditions necessary to secure success had gradually been established. In addition to the corporate training furnished by various companies, the state of New York had set an example, in her zealous support of the Erie Canal, which other commonwealths were disposed to follow. The United States government had built the national road, and advanced some money to canal schemes. Thus several possible methods of obtaining the means necessary to construct important lines had been suggested, and there was a fair prospect that promising routes might be supported either by private capital, or city or state subscriptions.

The fact was also clearly recognized that neither steamboats, turnpikes, nor canals would fully provide for all the transportation requirements of the country. There were thriving inland districts which could not be advantageously reached by any description of natural or artificial water courses.

PROGRESS OF STEAMBOAT MOVEMENTS.

The success which had finally attended steamboat operations, and the large number of districts in which steamboats had been introduced in the United States before active efforts to promote important railway construction were commenced, must have afforded considerable incidental aid, in various ways, to some of the early railway operations. At all events, it helped to train men in the operation of steam engines, to increase the amount of available mechanical knowledge relating to the application of steam to transportation either on water or on land, and to give to some of the ramifications of early American railway affairs the benefit of better training at the outset than would otherwise have been available. Such good fortune certainly awaited the early New Jersey railroads, which called into their service members of the Stevens family, who had been experimenting with or operating successfully steamboats for more than a score of years, and who were enabled, by this experience, to materially increase the practical value of their labors in the new field of effort in which they won new honors.

The progress of American steamboating from 1807 to 1830 is indicated by official statements, which show that the reported number and tonnage of steamers of all classes constructed was as follows:—

	No.	Tonnage.
From 1807 to 1820, inclusive	128	25,797.77
From 1821 to 1830, inclusive	385	65,211.60

Up to and including 1820 there had been built on the western rivers 71 steamers, measuring 14,207.53 tons; 52 steamers, measuring 10,564.43 tons, had been built on the Atlantic coast, exclusive of New England; 4 steamers, measuring 921.84 tons, including one steamer of 298.57 tons, built on lake Champlain, had been built on the lakes; and one of 218.84 tons had been built at Mobile. Up to and including 1830 there had been built on the western rivers 296 steamers, measuring 51,506.65 tons; 183 steamers, measuring 33,667.88 tons, had been built on the Atlantic coast, exclusive of New England, and 11 steamers, measuring 2,208.64 tons, had been built on the northern lakes.

After 1830 progress in the construction of steamboats on the western rivers, principally at Pittsburgh, Cincinnati, and Louisville, continued to be rapid, but the business was subjected to considerable fluctuations, growing out of variations in the demand for new transportation facilities or other causes.

The number of steamers built in New England from 1817 to 1830 inclusive, was 18, of an average tonnage of about 112.

Before 1830 lines of steamboats had commenced running in New England which connected ports of Maine and Boston.

The first steamer was introduced on lake Ontario in 1816; a steamer was launched on lake Erie in 1818, which traded as far westward as Mackinaw, Michigan, but was wrecked before the close of the year; several other lake steamers were built and operated before 1820; and during the third decade eight additional lake steamers were constructed.

Steamboats were introduced on several of the eastern rivers and especially on the Delaware soon after the successful operation of the Clermont on the North river in 1807.

In 1820 the steamers in service along the Atlantic coast were distributed as follows:—

AT NEW YORK.—The Connecticut and Fulton on Long Island sound, between New York and New London and New Haven, changing in 1822 to Providence. The Richmond, Chancellor Livingston, Paragon, and Car of Neptune on the Hudson, from New York to Albany, and the Fire Fly to Newburgh. The Olive Branch, New York to New Brunswick. The Swift, from New York to Elizabeth. The Franklin, from New York to Shrewsbury. The Atlanta, from New York to Elizabethtown Point. The Bellona, from New Brunswick to Staten Island, and the Nautilus, from New York to Staten Island.

AT PHILADELPHIA.—The Pennsylvania and Ætna were running from Philadelphia to Bordentown. The Philadelphia, from Philadelphia to Trenton. The William Penn and Bristol, from Philadelphia to Bristol. The Superior and Vesta, from Philadelphia to Wilmington, and the Baltimore and Delaware, from Philadelphia to New Castle.

AT BALTIMORE.—The United States and Philadelphia were running from Baltimore to French Town. The Virginia and Norfolk to Norfolk; the New Jersey to Elkton; the Maryland to Easton; and the Eagle and Surprise were on no regular routes.

AT WASHINGTON.—The steamer Washington ran to Fredericksburg, and the new steamer Potomac, built at Norfolk, was put upon the route between these two ports.

AT NORFOLK.—The steamers Roanoke and Richmond ran between that port and Richmond. The Powhatan, Petersburg, and Sea Horse were also on routes from that port.

AT SAVANNAH.—The steamer Enterprise, 152.10 tons' burden, was running to Charleston and river ports in that vicinity.

On the Atlantic coast the notable event had also occurred, in 1819, of fitting out the steamer Savannah, which had crossed the ocean, partly by the help of her sails, sailing from Savannah to Liverpool in twenty-five days, during eighteen of which her engine was worked. She was the first steamer to cross the Atlantic. A steamer was built, and operated for three years, to ply between New York, Charleston, Havana, and New Orleans, which made her first trip in 1820, and which was successful in regard to safety and speed, but unprofitable financially.

The number and tonnage of new steamboats or steamers constructed on the Atlantic coast, in New York, Philadelphia, and Baltimore districts, from 1821 to 1830 inclusive, was as follows:—

Year.	No.	Tonnage.
1821	6	668.30
1822	4	862.31
1823	4	636.97
1824	13	2,230.68
1825	15	2,837.75
1826	23	4,434.29
1827	14	3,081.36
1828	24	2,826.63
1829	15	3,399.04
1830	13	3,126.12

On western rivers steamboat construction previous to 1830 had been more rapid than in any other section. The progress was specially rapid from 1817 to 1830. It is stated that from 1817 to 1827 there were built at Cincinnati 52 steamers, measuring 9,306.61 tons. From about 1814 to about 1824 there were built at Pittsburgh 30 steamers, measuring 5,698.78 tons. From 1815 to 1825 there were built at Louisville 35 steamers, measuring 6,032.26 tons. From 1825 to 1830 the official records of construction of steamers on the western rivers in the Pittsburgh, Cincinnati, and Louisville districts show the following aggregates:—

Year.	No.	Tonnage.
1825	18	3,065 79
1826	35	6,563.76
1827	33	5,244.61
1828	19	3,043.05
1829	36	7,561.53
1830	33	4,811.15

These western river steamers were then running principally on the Ohio and Mississippi, but they were also traversing to some extent various tributaries of the Mississippi. It is stated that the Virginia, a stern-wheel boat, arrived at Fort Snelling, near the Falls of St. Anthony, in 1813. In 1817 a steamboat touched at St. Louis, and proceeded up the Missouri to explore that river. In the natural order of advancement, after steamboating was fully established on the Ohio and Mississippi, steamboats were rapidly introduced on all the navigable tributaries of those rivers, and, generally speaking, on them, as on all other navigable waters of the United States, the steamboat was introduced and operated extensively before railways were constructed in contiguous inland districts, the steamboat being very frequently the pioneer or predecessor of the locomotive.

But much as steamboats had done up to 1830, and a few years later, they were not meeting all requirements. The time had evidently come when it was not merely desirable to increase the number of steamboats on the Atlantic coast, the lakes, and western rivers; to utilize the canals then in existence, and to increase their number; but also to construct railways.

RAILWAYS COMPLETED OR PROGRESSING IN 1836.

In H. S. Tanner's American Traveler or Guide Through the United States, published in Philadelphia in 1836, the favorite routes of travel of that era are described at length, and the following list of railways then completed, or in course of construction, is given under the heads of the different states, viz.:—

ALABAMA.—A railroad is now in progress from Decatur, in Morgan county, to a point 10 miles below Tuscumbia, on the Tennessee. Length, 62 miles.

DELAWARE.—The New Castle and Frenchtown Railroad extends from New Castle to Frenchtown. Length, $16\frac{10}{100}$ miles. A railroad to extend from Wilmington to Downingtown, in Pennsylvania, is proposed.

GEORGIA.—Alatamaha and Brunswick Railroad, 12 miles in length.

KENTUCKY.—Lexington and Ohio Railroad, commences at Lexington, passes through Frankfort, and thence to shipping point, near Louisville. Length, 85 miles.

LOUISIANA.—The New Orleans and Pontchartrain Railroad, 5 miles long.

MARYLAND.—Baltimore and Ohio Railroad, extends from Baltimore to Point of Rocks, on the Potomac, $67\frac{5}{8}$ miles from Baltimore. This road is to be continued to the Ohio river. A road of a single track extends from the main line to Frederick, $3\frac{1}{2}$ miles. Baltimore and Susquehanna Railroad, commenced in 1830, is to extend to York, Pennsylvania. Length, when completed, 76 miles. Another railroad is projected, to extend from Baltimore to the Susquehanna at Port Deposit, and thence to unite with the Oxford Railroad, of Pennsylvania, which intersects the Columbia Railroad about 40 miles from Philadelphia. Baltimore and Washington Railroad. Length, $37\frac{3}{4}$ miles. This work is now completed.

MASSACHUSETTS.—Worcester Railroad, 43 miles in length. It is proposed to continue this road to the Connecticut, and to construct a branch to Milberry. Boston and Providence Railroad. Length, 43 miles. Boston and Lowell Railroad, length 25 miles, now in progress. Quincy Railroad, used for transporting granite from the quarry in Quincy to Neponset river. Length, 3 miles; branches, 1 mile.

MISSISSIPPI.—St. Francisville and Woodville Railroad, 26 miles in length. Vicksburg and Clinton Railroad, length 37 miles (proposed).

NEW JERSEY.—Camden and Amboy Railroad, commences at Camden, opposite Philadelphia, and terminates at South Amboy. Length, 61 miles. Paterson and Hudson River Railroad, from Jersey City, opposite New York, to Paterson, on the Passaic. Length, $16\frac{30}{100}$ miles. It is proposed to extend this road to the Morris Canal. New Jersey Railroad, commences on the last-mentioned railroad, about 2 miles from Jersey City, and terminates at New Brunswick. Length, 28 miles.

NEW YORK.—Mohawk and Hudson River Railroad, from Albany to Schenectady, 16 miles. Schenectady and Saratoga Railroad, from Schenectady to Saratoga Springs, 20 miles. Catskill and Canajoharie Railroad, from Catskill to Canajoharie (now in progress), 70 miles. Ithaca and Owego Railroad, 29 miles. Harlem Railroad, on Manhattan Island. Rochester Railroad (now in progress), from Rochester to a point below the Falls of Genesee. Schenectady and Utica Railroad (now in progress). Length, 80 miles. Bath Railroad, from Bath to Crooked Lake, 5 miles. Rochester and Batavia Railroad (now in progress), 28 miles. Troy and Ballston Railroad (now in progress), 22 miles. Several other roads are proposed in different parts of the state.

NORTH CAROLINA.—Railroads are projected to extend from Fayetteville to Cape Fear river; from Wilmington, through Fayetteville and Salisbury, to Beattysford, on the Catawba, a distance of 250 miles; and several others.

PENNSYLVANIA—*State Railroads.*—Columbia Railroad, extends from Philadelphia to Columbia, on the Susquehanna. Length, $81\frac{60}{100}$ miles. Allegheny Portage Railroad, from Hollidaysburg to Johnstown, forms the connecting link between the Central and Western divisions of the Pennsylvania Canal. Length, $36\frac{69}{100}$ miles. *Railroads constructed by joint stock companies.*—Mauch Chunk Railroad, from Mauch Chunk to the coal mines, 9 miles. Room Run Railroad, from Mauch Chunk to the coal mine on Room Run, $5\frac{26}{100}$ miles. Mount Carbon Railroad, from Mount Carbon to Norwegian valley, $7\frac{24}{100}$ miles. Schuylkill Valley Railroad, from Port Carbon to Tuscarora, 10 miles; branches of the preceding, 15 miles. Schuylkill Railroad, 13 miles. Mill Creek Railroad, from Port Carbon to the mines near Mill Creek. Length, including branches, 7 miles. Mine Hill and Schuylkill Haven Railroad, from Schuylkill Haven to the coal mines at Mine Hill. Length, including two branches, 20 miles. Pine Grove Railroad, 4 miles in length. Little Schuylkill Railroad, from Port Clinton to Tamaqua, 23 miles. Lackawaxen Railroad, from Honesdale to Carbondale, $16\frac{1}{2}$ miles. West Chester Railroad, from the Columbia Railroad to West Chester, 9 miles. Philadelphia, Germantown and Norristown Railroad, (about 7 miles of this road are completed; a new route to Norristown, leaving Germantown to the north-east, has been adopted.) Lykens Valley Railroad, from Broad Mountain to Millersburg. Philadelphia and Trenton Railroad, $26\frac{1}{4}$ miles in length. Central Railroad, from the vicinity of Pottsville to Sunbury, $44\frac{54}{100}$ miles; Danville branch, 7 miles long; whole length $51\frac{54}{100}$ miles. Oxford Railroad, now in progress, extends from the Columbia Railroad to the Maryland state line. Reading Railroad, to extend from Norristown to Port Clinton.

RHODE ISLAND.—Stonington Railroad, now in progress, extends from Stonington, in Connecticut, to Providence, 46 miles in length. A company has been incorporated to construct a railroad from Providence to Norwich, in Connecticut.

SOUTH CAROLINA.—South Carolina Railroad, commences at Charleston, and terminates in the town of Hamburg, opposite Augusta; entire length, $135\frac{75}{100}$ miles. It is proposed to construct a branch to Orangeburg, and thence to Columbia, &c., and another to Barnwell Court House.

TENNESSEE.—A railroad from the town of Randolph, on the Mississippi, to Jackson, in Madison county, 65 miles, and one from Nashville to New Orleans, are proposed, and measures for insuring their early completion have been adopted.

VIRGINIA.—Manchester Railroad, extends from Manchester to the coal mines. Length, 13 miles. Winchester Railroad, extends from Harper's Ferry to Winchester. Length, 30 miles. Petersburg and Roanoke Railroad, extends from Petersburg, in Virginia, to Blakely, at the foot of the Roanoke Canal, in North Carolina. Length, $59\frac{38}{100}$ miles. A branch of this road leaves the main line about 10 miles from Blakely, which extends to the head of the rapids of Roanoke. Length, about 12 miles. Portsmouth and Roanoke Railroad, commences at Portsmouth, opposite Norfolk, passes in a direct course, intersects the Petersburg road 6 miles from Blakely, and terminates in the Roanoke a short distance below the Petersburg branch. Length, 80 miles. Richmond and Petersburg Railroad (now in progress). Length, $21\frac{50}{100}$ miles. Richmond and Fredericksburg Railroad (now in progress). Length, 64 miles. Belleplain Railroad, extends from Fredericksburg to Belleplain, situated on a branch of the Potomac (in progress). Length, 11 miles. Several other railroads are proposed.

The reported number of miles of railway constructed in the United States in the third decade was 2,264.67. Of this mileage, the amount completed in each of the years named was as follows: 1830, 39.80; 1831, 98.70; 1832, 191.30; 1833, 115.91; 1834, 213.92; 1835, 137.82; 1836, 280.08; 1837, 348.38; 1838, 452.88; 1839, 385.88; total, 2,264.67.

Of these railways, the mileage located in New England was 356.68; in Middle states, Delaware, Maryland, and a few Western and North-western states, 1,399.89; Southern states, 487.35; South-western states, 20.75. The following table shows the number of miles completed by each company in the years named:—

NUMBER OF MILES CONSTRUCTED BY EACH CONSTRUCTING COMPANY IN EACH YEAR OF THE FOURTH DECADE.

	1830.	1831.	1832.	1833.	1834.	1835.	1836.	1837.	1838.	1839.	Decade.
Boston and Albany (portions of its lines)	....	....	....	....	31.60	12.50	....	....	20.33	54.53	118.96
Boston, Clinton, Fitchburg and New Bedford	....	....	....	....	....	....	11.10	....	....	....	11.10
Boston and Lowell	....	....	....	....	....	....	25.75	....	....	....	25.75
Boston and Maine	....	....	....	....	....	....	7.00	10.00	....	....	17.00
Boston, Revere Beach and Lynn	....	....	....	....	....	52.05	2.22	....	....	....	54.27
Eastern (of Massachusetts)	....	....	....	....	....	....	....	....	13.42	15.02	28.44
Nashua and Lowell	....	....	....	....	....	....	....	....	14.25	....	14.26
New York, New Haven and Hartford	....	....	....	....	....	....	....	....	....	36.00	36.00
New York, Providence and Boston	....	....	....	....	....	....	....	46.15	....	....	46.15
St. Croix and Penobscot	....	....	....	....	....	2.00	....	....	....	....	2.00
Whitefield and Jefferson	....	....	....	....	....	....	....	....	2.75	....	2.75
Total in New England states	....	....	....	....	....	....	....	....	....	....	356.68
Atlantic Avenue	....	....	....	....	....	....	9.68	....	....	....	9.68
Baltimore and Ohio	15.00	46.50	11.00	....	12.00	....	....	....	....	....	84.50
Cayuga and Susquehanna	....	....	....	....	34.61	....	....	....	....	....	34.61
Corning, Cowanesque and Antrim	....	....	....	....	....	....	....	....	....	14.81	14.81
Cumberland Valley	....	....	....	....	....	....	50.50	....	....	17.82	68.32
Detroit, Grand Haven and Milwaukee	....	....	....	....	....	....	....	....	13.00	....	13.00
Elmira and Williamsport	....	....	....	....	....	....	....	24.20	....	....	24.20
Franklin	....	....	....	....	....	....	....	....	....	5.85	5.85
Harrisburg, Portsmouth, Mt. Joy and Lancaster	....	....	....	....	....	....	25.00	9.00	1.54	....	35.54
Jeffersonville, Madison and Indianapolis	....	....	....	....	....	....	....	....	....	22.00	22.00
Lake Shore and Michigan Southern (portions of its line).	....	....	....	....	....	....	....	33.00	9.09	18.00	60.09
Lehigh Valley (portions of present line)	....	....	....	....	....	....	19.85	....	23.97	2.00	45.82
Little Schuylkill Navigation Railroad and Coal Co	....	20.00	....	....	....	....	....	....	....	....	20.00
Long Island	....	....	....	....	....	....	....	15.28	....	....	15.28
Michigan Central	....	....	....	....	....	....	....	....	29.50	7.80	37.30
Mill Creek and Mine Hill Navigation and Railroad Co	3.80	....	....	....	....	....	....	....	....	....	3.80
Mine Hill and Schuylkill Haven	....	10.00	....	....	....	4.20	....	2.50	....	....	16.70
Morris and Essex	....	....	....	....	....	....	22.07	....	....	....	22.07
New York Central and Hudson River (portions of its line).	....	17.00	....	3.00	....	....	77.66	3.00	26.02	53.10	179.78
New York and Harlem	....	....	....	1.00	2 00	....	....	2.00	....	2.00	7.00
Northern Central	....	....	8.60	....	....	....	....	....	57.10	....	65.70
Paterson and Hudson River	....	....	....	15.07	....	....	....	....	....	....	15.07
Pennsylvania (portions of its present line purchased from the state of Pennsylvania)	....	....	32.39	....	48.00	....	....	....	....	13.50	93.89
Philadelphia, Germantown and Norristown	....	....	....	3.00	17.20	....	....	....	....	....	20.20
Philadelphia and Reading	....	....	1.40	....	....	....	....	....	55.06	17.00	73.46
Philadelphia and Trenton	....	....	....	....	26.44	....	....	....	....	....	26.44
Philadelphia, Wilmington and Baltimore	....	....	7.25	....	....	....	1.41	93.00	2.00	....	103.66

	1830.	1831.	1832.	1833.	1834.	1835.	1836.	1837.	1838.	1839.	Decade.
Plymouth	....	....	....	....	....	....	3.00	....	....	....	3.00
Rensselaer and Saratoga	....	....	....	....	....	20.82	4.40	....	....	....	25.22
Sandusky, Mansfield and Newark	....	....	....	....	....	15.25	38.75	....	....	....	54.00
Saratoga and Schenectady	....	....	12 81	6.59	....	....	....	....	....	....	19.40
Schuylkill Valley Navigation and Railroad	11.00	....	....	....	....	....	....	....	....	....	11.00
Trenton and Delaware Bridge Company	....	....	....	....	....	....	0.19	....	....	....	0.19
United New Jersey Railroad and Canal Company	....	....	34.17	....	27.00	....	....	....	26.03	44.91	132.11
Washington Branch Railroad Company	....	....	....	....	....	31.00	....	....	....	....	31.00
West Chester Railroad Company	....	5 20	....	....	....	....	....	....	....	....	5.20
Total in states of New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, and District of Columbia	....	....	....	....	....	....	....	....	....	....	1,399.89
Chester and Lenoir Narrow-Gauge Railroad Company	....	....	....	....	....	....	....	....	....	34.54	34.54
Georgia Railroad and Banking Company	....	....	....	....	....	....	....	....	37.00	27.00	64.00
Petersburg Railroad Company	....	....	31.68	27.32	....	....	....	....	....	....	59.00
Richmond, Fredericksburg and Potomac	....	....	....	....	....	....	....	59.75	....	....	59.75
Richmond and Petersburg	....	....	....	....	....	....	....	....	22.50	....	22.50
Seaboard and Roanoke	....	....	....	....	....	....	....	....	78.56	.. .	78.56
South Carolina Railroad Company	10.00	....	52.00	75.00	....	....	....	....	....	....	137.00
Winchester and Potomac	....	....	....	....	....	....	32.00	....	....	....	32 00
Total in Southern states	....	....	....	....	....	....	....	....	....	....	487.35
Clinton and Port Hudson	....	....	....	....	....	....	....	....	20.75	....	20.75
Total in South-western states	....	....	....	....	....	....	....	....	....	....	20.75
Total in each year	39.80	98.70	191.30	115.91	213.92	137.82	280.08	348.38	452.88	385 88	2,264.67

A few of the early companies are not included in this list. Some of the unimportant primitive lines have been abandoned; for the name of the original constructing company there has been substituted, in some instances, the name of the present operating company; and there are probably a few omissions or slight inaccuracies in dates, but with these exceptions the table is presumably substantially correct, as it is compiled from the data furnished to the United States Census Bureau in 1880 by the companies then operating the existing lines. Some of the early coal railroads of Pennsylvania are not included in the list.

PROGRESS IN VARIOUS SECTIONS.

NEW ENGLAND AND NEW YORK RAILWAYS.

THE following was reported to be the result of the operations of the prominent Massachusetts roads in 1839:—

Name.	Length of road.	Cost of road.	Cost per mile.	Total expenses.	Total receipts.	Dividend. P. ct.
Boston and Lowell	25¾	$1,608,476	$62,465	$92,151	$241,220	8
Boston and Providence	41	1,782,000	43,460	93,562	313,907	8
Boston and Worcester	44½	1,799,225	40,433	126,384	231,807	6½
East'n (incomplete)	25	1,306,196	32,655	53,174	125,623	4⅔
Taunton branch	11	250,000	22,791	40,711	58,018	6
Nashua and Lowell	14¼	353,662	24,321	29,885	55,053	..
Total	161	$7,099,589				

Of the receipts, $682,387 were derived from passengers, and $343,240 from freight. The fact that these roads commenced paying liberal dividends at an early date, thus affording proof of financial success, did much to awaken a hope that similar results would be secured elsewhere. The line of greatest significance in New England in 1839 was the Boston and Worcester, and its proposed extension, the Western, which, combined with other links, subsequently became the Boston and Albany, and thus furnished a link, with portions of the existing Vanderbilt system, by which Boston expected to secure superior rail connections with the lakes and the Western states. Of the existing Boston and Albany system, 118.96 miles were completed in 1839.

A message of the Governor of the state of New York stated that at the close of 1839 the railroads of that state consisted "of a continuous line of railroad from Albany to Auburn, 170 miles, (which was owned and operated by four distinct companies;) a similar line from Lockport to Lewistown and Buffalo, 47 miles; a railroad from Rochester to Batavia, 35 miles; a railroad from Schenectady to Saratoga Springs, 21 miles; a railroad from Troy to Ballston Spa, 25 miles; a railroad from New York to Harlem, 8 miles; a railroad from Brooklyn to Hicksville, on Long Island, 27 miles; a railroad from the termination of the west branch of the Chemung Canal to the Tioga Railroad, in Pennsylvania, 14 miles; a railroad crossing the ridge between the Susquehanna at Owego and the Cayuga lake at Ithaca, 29 miles, and a railroad from the line of Massachusetts at West Stockbridge to the city of Hudson, 30 miles. These roads have all been constructed, and are managed by companies."

The state of New York pursued a peculiar policy in reference to railways at that time, inasmuch as it was unwilling to permit rivalry with the Erie Canal, and lines located near that canal, which were subsequently incorporated into the New York Central system, were at first not permitted to carry any freight. Subsequently they were allowed to carry freight on condition that they paid on it precisely the same tolls that would have been due to the state if it had been carried on the canals. After years of persistent efforts to secure state aid for railways the friends of the New York and Erie finally secured the passage of an act in 1837 providing that the commonwealth should furnish $3,000,000 towards construction, in the ratio of dollar for dollar, or with the understanding that as the company expended $100,000 they were to receive $100,000 from the state. Previous or up to 1840 the company had received $400,000 under this arrangement, and at that time 222 miles of the road were under contract. Portions of the route now occupied by the New York Central were then either operated or being constructed by nine companies. Some of these companies had achieved remarkable financial success. The Mohawk and Hudson, notwithstanding its deprivation of freight traffic, and the extra expenditures arising from the fact that it had been an experimental line, with unnecessary inclined planes, was dividing 12 per cent. per annum, and accumulating a surplus. The Utica and Syracuse had realized a net revenue of 10 per cent. during the six months ended December 31st, 1839.

NEW JERSEY IMPROVEMENTS—THE CAMDEN AND AMBOY.

The progress of the transportation movements in New Jersey is set forth in a report of the joint board of directors to the stockholders of the Delaware and Raritan Canal, and Camden and Amboy Railroad and Transportation Companies, presented at a meeting held on January 29th, 1840. After labors continued during a period of ten years this was the first detailed report issued, and it not only announced that the canal and railroad were completed, but that the pecuniary results and prospects were eminently satisfactory. It is scarcely to be expected that stockholders of the present day would be entirely satisfied if detailed statements were only submitted at intervals of ten years, especially while construction was progressing, but it has rarely happened that equally profitable results have been announced, either at long or short intervals. The report invited the closest scrutiny into expenditures of millions, and the cost of the works is reported to be $6,064,953.42, while the share capital was $2,900,000, the balance being borrowed at an average interest of 6 per cent. Of the public results secured it says: "Formerly the passage between Philadelphia and New York occupied from eleven to twenty hours, and was performed with great personal discomfort and no small hazard of limb and life. Merchandise was transported from city to city at great expense of insurance as well as of freight, and subject to all the difficulties, uncertainties, and danger of a coasting voyage. Now passengers are carried from city to city, during the most inclement seasons, in from six to seven hours, and with nearly the same comfort as they enjoy at their own firesides. Merchandise is transported in less time, with less expense, and with an entire saving of insurance." The Delaware and Raritan Canal was referred to as a work of 65 miles in length, which was adding year after year greatly to the value of the agricultural interests of New Jersey, and which would probably have its revenues materially increased after the completion of the Reading railroad to the anthracite coal region. Of the financial results the report states that during the previous six months there was a profit of 7 per cent., and a table was published to show that during the previous seven years there had been an annual increase of the profits of the companies of 20 per cent., and that if this ratio continued during the succeeding seven years, a dividend of 28 per cent. per annum would then be earned.

The statement of financial results from 1833 to 1839 inclusive, embraced the following record:—

Year—from Jan. 1st to—	Gross receipts.	Gross expenditures.	Net gain.
December 31st, 1833	$468,142 50	$287,091 90	$181,050 60
December 31st, 1834	546,993 54	313,261 69	233,731 87
December 31st, 1835	679,463 63	317,491 76	361,971 87
December 31st, 1836	770,621 28	363,344 90	407,276 38
December 31st, 1837	731,995 24	359,510 44	372,484 80
December 31st, 1838	754,989 89	355,249 10	399,740 79
December 31st, 1839	685,329 76	258,043 48	427,286 28

The report refers to an arrangement with the Philadelphia and Trenton Railroad Company, made in June, 1836, "by which the receipts of the companies were amalgamated, so as to divide on the shares of the companies, share and share alike, and to equalize the dividends." It states that this arrangement had been attended with the most beneficial results. It was one of the first instances, if not the first, of a consolidation of railway lines located in adjacent states.

The report is signed by James Parker, chairman of the joint board, and the following directors: R. F. Stockton, Robert L. Stevens, Abraham Brown, John C. Stevens, W. McKnight, J. Kaign, G. D. Wall, B. Fish, J. S. Green, J. W. Mickle, J. Nelson, J. R. Thomson, E. A. Stevens.

One of the remarkable paragraphs of the report, in a personal point of view, is the following: "Although we cannot attempt to name all the individuals from whom we have obtained advice and assistance during the progress of our labors, still we may not overlook the important and invaluable aid we have received from one of the directors, (now absent,) Mr. John Potter, of New Jersey, formerly of South Carolina. To his enterprise, firmness, and public spirit are the public, as well as ourselves, more indebted, perhaps, than to any other individual for the successful issue of your affairs."

Another feature of the report which excited much attention, and probably had much to do with the practical abandonment of canal construction by companies, was its explanation of the fact that the railway had been quite profitable, while the canal had done very little more than pay expenses. In six years the gross receipts of the railways of the company had been $4,169,492; expenses, $1,966,901; net income, $2,202,591. During the same period, from 1834 to 1839, inclusive, the receipts of the Delaware and Raritan Canal were $306,895; expenditures, $210,344; net income, $96,551. As the canal had cost $2,829,769, and the railway but little more, it did not require much argument to satisfy investing projectors that it was better to support a class of undertakings which had yielded $2,202,591 net profit during six years than a class which had yielded only $96,551, both being managed by the same company. Many of the statesmen of the day, however, continued to favor canals. They seem to have always had a partiality for water routes when questions involving expenditures of public money were agitated.

DELAWARE AND MARYLAND IMPROVEMENTS.

The New Castle and Frenchtown, the first railway in Delaware, and one of the first in the United States, formed an important link in a through north and south route. The Philadelphia, Wilmington and Baltimore supplied useful railway facilities to portions of Delaware and Maryland, as well as to sections of south-eastern Pennsylvania.

In Maryland the Baltimore and Ohio, and the Baltimore and Susquehanna, the latter being the progenitor of the Northern Central, had been started by private companies, at a very early period, and liberally aided by financial assistance in the shape of loans or stock subscriptions of the state of Maryland and the city of Baltimore. By the close of 1839 the Baltimore and Susquehanna had extended its lines into Pennsylvania, and the Baltimore and Ohio had a fair start towards the extension of its lines to the Ohio river.

IMPROVEMENTS IN PENNSYLVANIA AND SOUTHERN AND WESTERN STATES.

The number of miles of railway in operation, and number of locomotives in 1839–40, in the states named below, was reported in 1840 by Chevalier DeGerstner, who had come to this country for the express purpose of examining the American railway system, visiting nearly all the lines, and who was then said to possess more information on that subject than any other person, to be as follows:—

	No. of railroads, including unfinished lines.	Total length.	No. of locomotives.
Pennsylvania	40	576½	114
Virginia	10	341	42
North Carolina	3	247	11
South Carolina	2	136	27
Georgia	4	211½	17
Florida	4	58½	5
Alabama	7	51	3
Louisiana	10	62	20
Mississippi	5	50	8
Kentucky	2	32	2
Ohio	6	39	1
Indiana	2	20	2
Michigan	10	114	8
Illinois	11	23	2
	116	1,960½	262

A considerable number of the railways then in operation continued to use horses or mules as a substitute for locomotives.

The longest continuous line of railroad then in operation in Pennsylvania (and one of the longest in the United States), extended from Philadelphia to Greencastle, a distance of 163 miles. The only lines in Pennsylvania on which locomotives were then used, and the number on each, was as follows: Philadelphia and Columbia, 36; Allegheny Portage, 17; Philadelphia, Germantown and Norristown, 8; Philadelphia and Trenton, 5; Philadelphia and Wilmington, 4; Harrisburg and Lancaster, 8; Cumberland Valley, 8; Franklin, 1; Beaver Meadow, 6; Hazleton branch, 3; Sugar Loaf Summit, 1; Little Schuylkill, 5; Pottsville and Danville, 2; Williamsport and Elmira, 1; Blossburg and Corning, 2.

In Pennsylvania, in 1839, $18,050,450 had been expended on railways, of which sum about one-third represented the cost of the state railways, the Philadelphia and Columbia, and the Portage road. This was considerably more money than had then been expended for railways in any other state. The bulk of the private capital had been invested in roads leading to or from the anthracite coal regions, and most of these undertakings, in turn, were comparatively short lines, connecting the mines with canals. The most extensive of the new coal roads, however, the Philadelphia and Reading, of which 54½ miles were opened in 1839, and 15 more then graded, was a much more ambitious undertaking, inasmuch as it aimed at carrying coal by rail from the Schuylkill region to Philadelphia, in competition with the Schuylkill Canal, which had previously monopolized that traffic, and on account of this threatened competition the stock of the Schuylkill Navigation Company had declined greatly in market value. Independent of the coal roads and the state roads, the Philadelphia, Germantown and Norristown; Cumberland Valley; West Chester; Philadelphia and Wilmington, which formed the link in Pennsylvania of the Philadelphia, Wilmington and Baltimore; the Philadelphia and Trenton, which formed the Pennsylvania branch of the New Jersey railway system; the Harrisburg and Lancaster, now part of the Pennsylvania Railroad, and Williamsport and Elmira, connecting a portion of northern Pennsylvania with southern New York, were in operation. The Cumberland Valley, and Philadelphia, Germantown and Norristown, although finally very successful, were at an early stage of their history regarded as very unpromising enterprises. Of the Philadelphia, Wilmington and Baltimore it was reported in 1839 that its net income was $194,503, which was considered sufficient to justify a liberal dividend. Philadelphia had also built three railways within her limits, to be operated chiefly, if not exclusively, with animal power, which had an aggregate length of six miles. The Philadelphia and Columbia Railroad had cost $48,780 per mile, and the Allegheny Portage road $50,450 per mile, and they were two of the most expensive roads that had then been built in the United States. The estimated cost of the Reading was also unusually large, being at the rate of $45,000 per mile. But nearly all the other roads were comparatively cheap, and the estimated cost per mile of all the railways in Pennsylvania then finished, and in process of construction, was $27,130 per mile.

RAILWAYS IN SOUTHERN AND WESTERN STATES.

Of the railways in operation in Virginia, North and South Carolina, and Florida in 1839, all used locomotives except two short lines. While the mileage then in operation in those states was 994, there was an additional mileage of 301 graded, and 380½ projected, making the total mileage in those states, completed and contemplated, 1,675½. The amount of capital that had been expended on construction was $18,442,000, and the estimated additional amount necessary for completion was $7,770,000, making the total cost $26,212,000, and the average cost per mile $15,644.

These lines were the first to form continuous systems of considerable magnitude, one of which extended from Fredericksburg, Va., to Wilmington, N. C., a distance of 304 miles, and another from Fredericksburg to Raleigh, N. C., a distance of 227½ miles.

The railroads in operation in Alabama, Louisiana, Mississippi, Tennessee, and Kentucky in 1839 had an aggregate mileage of 195, but 421 additional miles were graded, and 532¼ projected. The amount of capital already expended was $9,621,000, and the estimated amount necessary to complete the unfinished lines was $9,613,000, a total of $19,234,000, and an average cost per mile of $16,750.

The length of the railroads in operation in Ohio, Indiana, Michigan, and Illinois was 196 miles; additional mileage graded, 533; not yet constructed, 2,092½, and the aggregate length of the projected systems was 2,821½ miles. The amount of capital expended had been $5,523,640, and the estimated additional amount necessary for completion was $27,114,500, making the total cost $32,638,140, and the average cost per mile $11,568. Of the completed mileage of these states, 56 were operated with horse power, and on 140 miles locomotive engines were run.

THE GENERAL RESULTS.

It will be seen that up to 1840 no continuous road of considerable length had been completed by any single company, and most of the mileage existing at the end of the fourth decade represented detached enterprises, which either served purely local purposes or acted as connecting links between natural or artificial water-courses. The germ of great systems, however, had been established, and notably of the Pennsylvania, New York Central, and Baltimore and Ohio. A number of the lines constructed by private companies had, at the outset, greatly disappointed the expectations of their projectors, and proved unprofitable. Some schemes, after being well advanced, were abandoned for years on account of financial stringency arising from the panic of 1837. In some of the cases where state or city aid had been granted, peculiar difficulties had sprung up, and in other cases the results were not entirely satisfactory for various reasons. It seems to rarely require much experience to convince some of the parties interested that railways are not invariably an unmixed blessing.

At the close of 1839 there was no extensive continuous internal improvement of a single given character and ownership extending through a number of states except the National road, a superior turnpike, which had been constructed by appropriations of the United States government, made during a period of about thirty years. The only other extensive continuous systems under a single management were the New York canals and the main line and branches of the Pennsylvania system of internal improvements, which incidentally included two railways that were about 120 miles in length. But the necessary means for both these undertakings were obtained from state treasuries, and mainly through the proceeds of the sale of state bonds. No private company up to that time possessed sufficient capital or credit to construct a continuous railway of considerable length, and in the absence of state aid it would then have been useless to attempt to build such lines. The longest route of continuous land travel, interspersed with occasional steamboat trips and staging, but made up largely of railway links, was on the great north and south mail route, extending from Boston to New Orleans, near the Atlantic seaboard and gulf of Mexico, but ambitious efforts were then, as in all subsequent periods, generally directed towards the improvement of lines and systems extending westward, and the prominent competitors for western traffic, to be won by railway extensions included Boston, New York, Philadelphia, Baltimore, Charleston, and Savannah.

A distinguished Frenchman, Monsieur Chevalier, who visited this country in 1838, said of the great public works then progressing in the United States that "they must have for their objects:—

First. To bind the shores of the Atlantic with the country west of the Allegheny; that is to say, to connect rivers, such as the Hudson, the Susquehanna, the Potomac, the James river, or bays, such as the Delaware or the Chesapeake, either with the Mississippi or its tributary, the Ohio, or with the St. Lawrence, or the great lakes, Erie and Ontario, whose waters are conveyed by the St. Lawrence into the sea.

Second. To establish communications between the valley of the Mississippi and that of the St. Lawrence; that is to say, between one of the great tributaries of the Mississippi, such as the Ohio, the Illinois, or the Wabash, and lake Erie or lake Michigan, which lakes of all those which have an outlet by the St. Lawrence extend furthest south.

Third. To connect the north and south poles of the Union, New York and New Orleans.

Independently of these great systems of public works, which are in progress of construction, and even in part executed, there exist secondary groups of lines of transportation, having for objects either to facilitate access to centres of consumption or open outlets to certain centres of production. The first of this class of cases embraces different works, canals, or railroads, which leave the great cities as centres, and radiate in different directions around them. The second comprises such works as have been executed to bring into market different coal fields."

The first single line in the United States to attain considerable length was that of the South Carolina Railroad Company, or the South Carolina and Hamburg road. In 1833 it had 137 miles in operation, and it constructed the first continuous 100 miles of railway that were built in any part of the world. In 1834 active efforts were being made to extend its system to Louisville and Cincinnati.

The largest amount of mileage embraced in any of the continuous existing systems which was finished in 1839 was that reported by the New York Central, consisting of 179.78 miles, but at that time this mileage was owned and controlled by a number of distinct companies.

A much larger amount of the mileage now controlled by the Pennsylvania was in operation in 1839, and it includes the following lines, viz: Cumberland Valley, 68.32; Elmira and Williamsport, 24.20; Harrisburg, Portsmouth, Mount Joy and Lancaster, 35.54; Jeffersonville, Madison and Indianapolis, 22.00; Northern

Central, 65.70; Philadelphia and Columbia, etc., 93.89; Philadelphia and Trenton, 26.44; Philadelphia, Wilmington and Baltimore, 103.66; United New Jersey Railroad and Canal Company, 132.11; West Chester, 5.20; total, 444.95 miles.

The Baltimore and Ohio mileage in 1839 consisted of 84.50 miles on its main line and 31 on the Washington branch.

The Boston and Albany mileage was 118.96.

It would be idle to attempt to describe the particular events that made up the history of any of the lines that gradually familiarized the inhabitants of one section after another with a tangible idea of a railroad. Wherever engineers and contractors prosecuted their labors vigorously the process of filling up valleys, making deep cuts in elevated regions, and bridging streams and rivers, excited wonder and led to a variety of incidents and complications. The changes effected and foreshadowed were so numerous and momentous that in many localities a new point of departure in rural chronology was furnished by the time the railroad was built. There were a variety of trials and vicissitudes, industrial revolutions, fortunes made and lost, distressing accidents, some parties highly pleased and others terribly indignant, and often an influx of immigrants who followed in the wake of the advancing line, some of whom became permanent residents. For some communities and individuals the railway did much, for others comparatively little, and to a few it may have been a positive injury. But there was no line which did not serve one of the chief ends of modern life by promoting the greatest good of the greatest number affected.

EARLY RAILWAY FINANCIERING.

To form an adequate conception of the financial arrangements of the early railway lines it is necessary to consider various peculiarities of the period extending from 1830 to 1840.

The success of the Erie Canal, completed in 1825, had created a strong popular feeling in favor of state aid to internal improvements, and at the same time had made a number of states more favorably disposed to large grants of money, in the shape of appropriations, loans, or stock subscriptions, to canals and river improvements, than to railways. Canals and river improvements, indeed, found much favor from a number of legislators at times when they would not seriously consider propositions to aid the construction of railways.

The friends of the latter class of improvements, however, were very persistent in their efforts, and finally secured

STATE AID, IN VARIOUS SHAPES,

for some of the lines that were being constructed, especially such as were believed to be of state significance, from a considerable number of commonwealths.

As years progressed, with large annual expenditures for canals, railways, and other internal improvements, the burden of state debts rapidly increased, and the growing pressure of this burden was so much intensified by the panic of 1837 that shortly after 1840 a great fall occurred in the price of the bonds of a number of states, which represented, in a large degree, the cost of canals and railways.

Closely interwoven with this subject was the

SYSTEM OF STATE BANKING

then pursued. After the refusal of Congress to recharter the United States Bank each commonwealth chartered all the banks located within its boundaries. Nearly all these banks were authorized to issue paper money. A few of them were granted banking privileges chiefly for the purpose of enabling them to provide means for constructing railways. The amount of specie in the country was comparatively limited, and the credit of many of the banks was at such a low ebb that their notes could not be passed or used at places distant from the point of issue unless a heavy discount was paid.

The real foundation of a large proportion of the entire financial system of the country was the credit of the various states, represented by state bonds which had been sold in the financial marts of this and other countries, and this credit was steadily being weakened after the panic of 1837, partly by the commercial collapse which then occurred; partly by the folly, corruption, and extravagance intermingled with a number of the canal and railway projects; partly by the excess of imports over exports, and partly by abuses of the rickety system of state banking. The final result was a terrible financial explosion, which broke many of the banks, deranged nearly every branch of business, reduced the revenues of the struggling railway companies, and which was specially injurious to a number of the lines which had been constructed with money obtained from stockholders and loans, and without any aid whatever from state governments.

It was a fortunate circumstance that a considerable proportion of the early railway mileage was undertaken by

CAPITALISTS WHO RECEIVED NO AID WHATEVER FROM ANY OF THE STATE GOVERNMENTS,

and the success of a few of such lines, despite the follies and failures briefly referred to above, together with the ability of some of the railway lines which had received aid in the shape of state loans to meet the corresponding interest obligations, had an important effect in promoting the revival of confidence in railway enterprises.

It was an exceedingly difficult thing, requiring an immense amount of persistent effort, to secure the money necessary to construct any lengthy or extensive line, without state aid. The most notable achievement of that kind, during the period under consideration, was the completion of the Delaware and Raritan Canal and the Camden and Amboy Railroad and its branches, by the United Company of New Jersey, not only without advances from New Jersey, but under conditions which ensured the payment of a considerable sum, annually, into the treasury of that state, and the establishment of these enterprises on a basis which rendered them profitable to their owners and afforded satisfactory security to their creditors. About one-half the original cost of these works was contributed by stockholders, and the remaining half, or about $3,000,000, raised by a loan negotiated in England by Commodore Stockton. It was the largest sum that had then been advanced by foreign capitalists to any American transportation company that was not backed by state credit. Another fact, relating to this enterprise, which had an important bearing on subsequent railway development, was that it was the railway branch of their undertaking which made the profits and sustained their credit, inasmuch as the canal, although one of the best ever constructed, scarcely paid more than its operating expenses during the ten years which followed its completion.

DEMORALIZING EFFECTS OF THE CONSTRUCTION OF INTERNAL IMPROVEMENTS BY STATES.

Of the general effect of state advances to construct improvements, during an era when New Jersey pursued the opposite policy of entrusting similar works to incorporated companies alone, Commodore R. F. Stockton, writing in May, 1864, in defence of the New Jersey system, said:—

"The experience of several states in the management of railroads and canals has proved that politicians could not do as well for the state with the public works as they could do for themselves. New Jersey, although importuned by many to take charge of the Delaware and Raritan Canal and the Camden and Amboy Railroad, seems to have determined to give herself ample time to reflect upon the policy of managing the railroad and canal through the instrumentality of politicians, or leaving them, as at present, in charge of incorporated companies. I will venture to say, however, without claiming to be a prophet, that it will probably be a far distant day when the state of New Jersey will find it conducive to the public welfare for her to assume the proprietorship and management of any railroad or canal; although I well know that every railroad charter granted by the legislature reserves to the state the right to take the railroad provided for on payment of cost. And this brings me to a brief reference to some of those moral and political considerations, which much more than the question of dollars and cents, determined the action of New Jersey in 1830 and 1831. In 1830 the people of New Jersey were for the most part an agricultural people; there was not then any city but Newark, which had grown to be beyond a respectable village, and Newark was only a thriving manufacturing town; the farms were small, and wealth was confined to a very limited number; the habits, tastes, and manners of the people were plain and frugal, and morality and virtue held in high esteem. The rapid growth of wealth and corruption in the neighboring states had not contaminated the simplicity and republican equality which everywhere prevailed in New Jersey. But the public men and reflecting minds in New Jersey had perceived the demoralization and deterioration of virtue, which already began to be flagrant in those states in which lavish expenditures for internal improvements, and vast state patronage, incidental to state management of public works, had taken place. Particularly they had marked the headlong and reckless precipitancy with which corrupt demagogues had plunged the noble state of Pennsylvania into the vortex of enormous debt. This career of profligacy and crime was viewed in New Jersey with horror and disgust. . . . Had New York, Pennsylvania, Ohio, Virginia, and Indiana adopted the policy of New Jersey they would not probably have been the scenes of such stupendous profligacy as have characterized their legislatures within the last quarter of a century."

The companies which were probably next in importance to the New Jersey companies in establishing the fact that railways, unaided by state loans or appropriations, could be made profitable undertakings, if they were judiciously located, were some of the

EARLY MASSACHUSETTS AND NEW YORK LINES,

and notably the Boston and Lowell, which was reported to be, at the time of its completion, the best-constructed line in the United States, and a line doing an unusually large amount of profitable freight and passenger business. As it ran between Boston, the leading New England seaport, and Lowell, a manufacturing centre of rapidly increasing importance, it probably bore a closer resemblance than any other early American line to the phenomenally successful English line between Liverpool and Manchester, and derived from this resemblance the most important elements of its success. Early New York lines, which now form part of the New York Central system, were built wholly by private capital, and most of the early New England lines were also placed on a profitable basis soon after their completion. The stock of the New Castle and Frenchtown sold at a considerable advance on par value soon after it went into operation, and equal good fortune attended the South Carolina Railroad, which at the outset had only received state aid to the limited extent of a loan of $100,000.

Neither Massachusetts nor New York commenced granting state aid to railways at a period as early as it was granted in some of the other states, but they were finally induced to extend such assistance to a limited amount some years after their legislatures had turned a deaf ear to the first appeals of enthusiastic projectors.

Before 1842 Massachusetts had loaned credits to railway companies to the extent of $5,555,000, of which $4,205,000 was to secure the extension of the Western (now part of the Boston and Albany) to the North river, which was intended to obtain, by connections with the lines then rapidly being united, which parallel the Erie Canal, and now form part of the New York Central, a through rail connection with Buffalo, and thus an important share of the growing trade of the Western states. Exclusive of this loan of credit to railways, the other funded debt of Massachusetts was only $1,365,500, and in 1840 she had 383¾ miles of railway completed, which had cost $15,329,192, an average of $40,024 per mile, and which was constructed mainly by the money provided by stockholders who were nearly all receiving dividends ranging from five to seven per cent., the average rate being 7½ per cent.

In New York, shortly after 1840, the system which began with a loan of state credit of $3,000,000 to the New York and Erie Railroad, had extended to loans aggregating $2,235,700 to ten other companies, the largest item of which was $800,000 to the Delaware and Hudson Canal.

IN PENNSYLVANIA

there were, in 1839, two railways which had been constructed outright by the state, and were then operated by it to the extent of keeping up the roadway and furnishing motive power, while private individuals or companies supplied the cars used. They were the Philadelphia and Columbia and the Allegheny Portage, which formed important links in the main line of railways and canals connecting Philadelphia and Pittsburgh. The state also owned a small amount of railway stock; one of the lines it aided was the Cumberland Valley, and another the Franklin; but these outlays represented a comparatively trivial investment, or only a few hundred thousand dollars, and the thirty-eight companies which at that time had either completed or were constructing railway lines were obliged to secure nearly all the capital they expended from stockholders or creditors. So far as railways were concerned there had been expended upon their construction in Pennsylvania, up to the end of 1839, $18,050,450, of which sum $5,850,000 had been expended by the state on its state railways, and all the remaining outlay, except a few hundred thousand dollars represented by state stock subscriptions or appropriations, had been provided by private companies.

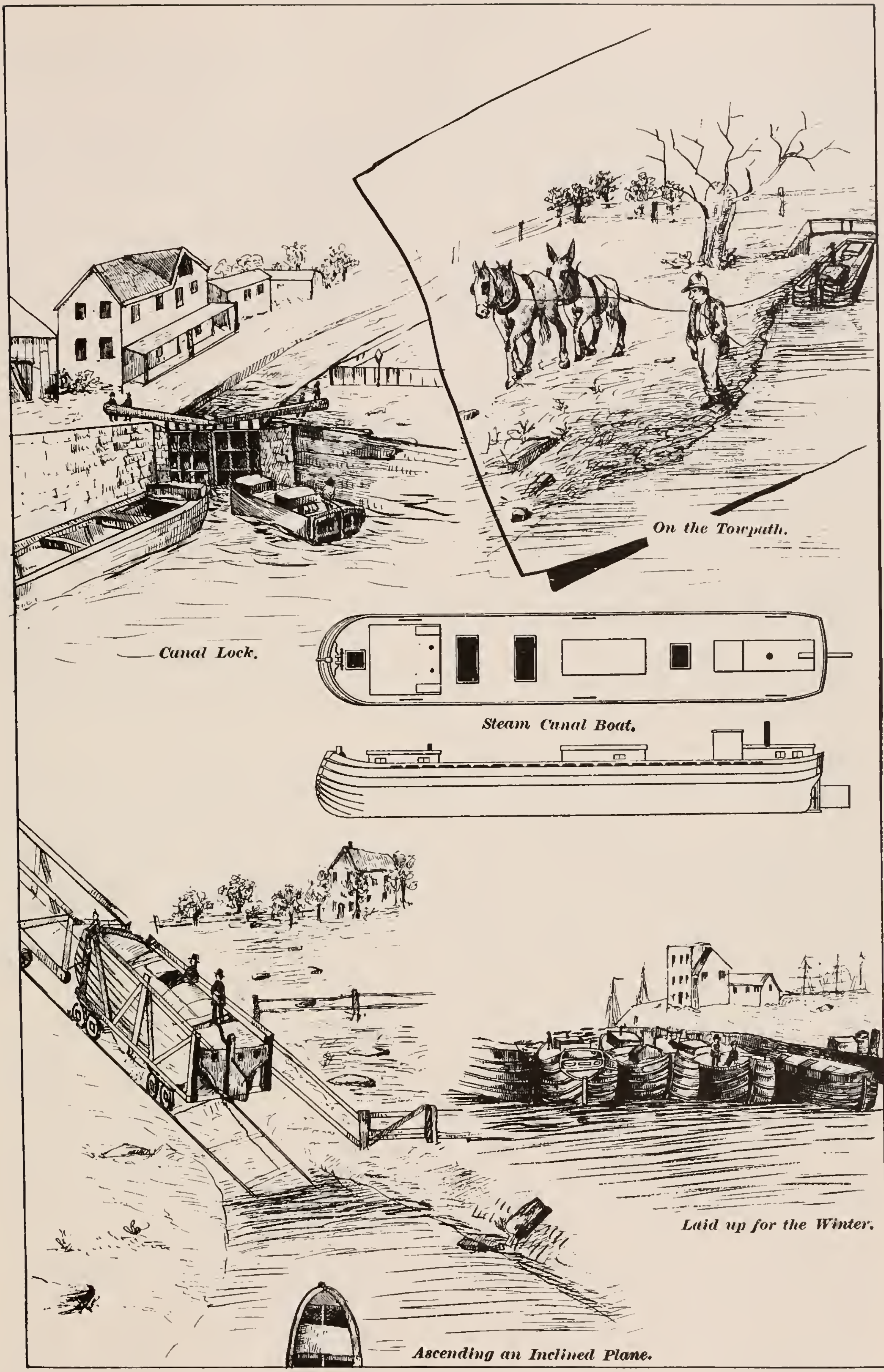
Although the state railways of Pennsylvania failed to prove profitable ventures to the commonwealth, they did not form a burden of considerable magnitude, but her large outlay for canals, much of which was wholly unremunerative, a number of the canals even failing to pay operating expenses, were leading influences in precipitating the collapse of credit which resulted from a failure to provide for the prompt payment of interest on her state bonds, that led to a decline in the price of those bonds to little more than one-third of their face value. They were quoted in 1842 at 40, and at one time were sold at 33 cents on the dollar. As Pennsylvania had a larger state debt than any other commonwealth (but by no means as large a debt in proportion to population and intrinsic wealth as some of the western and south-western states), her temporary failure to meet interest obligations was one of the most serious of many contemporaneous shocks to American credit. But the manly action of her citizens and legislators, after they fully comprehended the situation, in providing by an onerous tax system for the payment of her debts did much to restore confidence in American securities.

MARYLAND,

like Pennsylvania, suffered much more severely from investments in canals than in railways. Of a total debt of more than fifteen millions of dollars, more than seven millions had been sunk in the Chesapeake and Ohio Canal, and one million in the Susquehanna and Tide-water canals. Unlike Pennsylvania, she had agreed to advance considerable sums, in the shape of state bonds, to railways managed by railway companies, but as she took the precaution to provide that these bonds should not be sold for less than their par value, many of the bonds had not been disposed of before the crash came. The portion of the state debt in 1842 which represented bonds given to aid railways, some of which had been sold, while others were not disposed of, was as follows: Baltimore and Ohio Railroad, $3,697,000 (of this, $3,000,000 had not been sold); Baltimore and Washington, $500,000; Baltimore and Susquehanna (now the Northern Central), $2,223,731.65; Eastern Shore, $151,744.13; Annapolis and Elk Ridge, $219,378.41. The state bonds of Maryland were quoted in 1842 at 60.

VIRGINIA

adopted the policy of subscribing for two-fifths of the stock of all her chartered railways as soon as the other three-fifths of the stock supposed to be necessary to secure construction were subscribed by private individuals. Under this system, 369 miles of railway were in operation in 1839, and 28 miles in course of construction. The total cost of all lines was $5,451,000, an average of $14,772 per mile. The most expensive line extended from Richmond to Petersburg, 22½ miles in length. It had cost $31,111 per mile. The state debt of Virginia in 1842 was $6,994,307, which was incurred principally for improving the



On the Towpath.

Canal Lock.

Steam Canal Boat.

Laid up for the Winter.

Ascending an Inclined Plane.

navigation of rivers, turnpikes, railroads, and canals. None of her state bonds were reported to be in the market in 1842.

NORTH CAROLINA

was comparatively slow in commencing railway operations. Aside from the completion of a short line called the Experimental, 1½ miles in length, leading from Raleigh to stone quarries, she had no completed railways before 1840; but early in that year two roads were finished, the Raleigh and Gaston, 84½ miles in length, and the Wilmington and Raleigh, leading from Wilmington to Weldon, 161 miles in length. The latter road was reported to be the longest line completed by a single company that had been built in the United States. It was also distinguished by having an uninterrupted straight line of 47 miles in length. As the state of North Carolina had no debt in 1842, it presumably furnished little or no financial aid to the railways constructed within her boundaries. They were cheap roads, the total cost of her 247 miles being $3,163,000, and the average cost $12,806 per mile.

IN SOUTH CAROLINA

a peculiar policy prevailed. In one important respect it resembled the course pursued in New Jersey, inasmuch as all the railway operations within the state were to be undertaken by one company. It built the Charleston and Hamburg, without any other state aid than a loan of $100,000; but when branches were commenced, one of which led to Columbia, the state capital, additional state assistance was granted. This was supplemented by further aid, or a promise of it, to the amount of several millions of dollars, when the project of constructing an extension to Cincinnati and Louisville was organized. It took the shape of a new company, to be called the Louisville, Cincinnati and Charleston, which theoretically or actually became the purchaser or possessor of the property of the South Carolina Railroad. The scheme was vigorously agitated, but did not materialize with the rapidity anticipated, probably on account of the neglect or refusal of the adjacent states of North Carolina, Tennessee, and Kentucky, through whose territory the line was to run, to respond to the appeals made to them for state aid.

IN GEORGIA

the state had largely or wholly provided for the construction of one railroad, and others were undertaken by private companies, to which banking privileges had been accorded for the purpose of assisting them to raise the necessary capital. This last device had been proposed in Massachusetts, at a comparatively early period, to promote the construction of the Western Railroad, in which her citizens were deeply interested, but it had been rejected in that state mainly on account of political reasons. In Georgia it was probably more successful than in any other state, and under it the operations of the Georgia Railroad and Banking Company, and the Central Railroad and Banking Company, of Georgia, were vigorously prosecuted.

SOUTH-WESTERN AND WESTERN STATES.

In south-western localities, and notably in Mississippi and Louisiana, where railway operations were coupled with banking privileges, the combination seems to have been particularly unfortunate, as some of these institutions figured prominently in lists of broken banks.

Aside from these experiments, Indiana and Michigan each undertook the construction of short state railways, and Michigan commenced the construction of three lines which were to have an aggregate length of 486½ miles, and to cost $6,446,000, and this state temporarily operated a line of about 38 miles in length by furnishing not only the roadway and motive power, but also the cars and ageucies, so that Michigan acted in the fullest sense as a common carrier for her citizens. Indiana and Illinois plunged heavily into debt for internal improvements, and Illinois was specially rash in attempting the construction of a number of railway lines which she was unable to finish. One of the results of these ventures, and other untoward events, was that in 1842 Indiana had a state debt of $15,000,000, which was selling at 20 per cent. of par value; Illinois, a state debt of $17,643,601, which was selling at 18 per cent. of par value; and Michigan, a state debt of $5,611,000, which was selling in 1842 at 20 per cent. of par value.

The aggregate amount of

ALL THE STATE DEBTS IN 1842

was $207,564,915, and their market value in that year was $105,184,595, being a depreciation of 46⅞ per cent. State bonds then furnished favorite subjects for speculation at stock boards very much as railway securities do now. Railway stocks were only dealt in to a moderate extent, but even then the few stocks that were frequently bought and sold were subjected to noticeable fluctuations. Niles' Register, of August 8th, 1840, gives the following table of changes in the New York market in that year:—

	April.	May.	June.	July.	Aug. 1.
Harlem Railroad	45½	45½	4t	41½	36½
Utica Railroad	122½	..	..	13t	..
Boston and Providence Railroad	96	92½	93¼	98½	92
New Jersey Railroad	77½	83½	80¾	98½	92
Stonington Railroad	13	17½	15¼	18	18¼
Syracuse and Utica Railroad	109¼	114	119	121¼	..

A large proportion of the state debts were contracted for the purpose of constructing canals and railways, but the outlay for canals was considerably greater than the sums advanced by the states to the railways, and the ultimate losses on canal investments were much larger. It was estimated in 1842 that from 1820 to 1838 the legislatures of the several states had authorized debts aggregating $60,201,551 for canals, nearly all of which became unremunerative as an investment, while they authorized debts for railways amounting to $42,871,084, a large portion of which proved remunerative as an investment.

EFFECTS OF STATE AID.

With so many elements of danger environing the financial system of the country, including broken banks, depreciated state credit, commercial derangements, and unprofitable operations of a number of the private canal and railway companies, the pioneer railway projectors were reared in a stern school. In view of the great possibilities of state aid, which existed during the third decade of the nineteenth century, it is not surprising that they made many adroit and earnest appeals to the legislatures of a number of commonwealths for financial assistance.

One of the lessons which many of the events of the epoch helped to enforce was that the best method of advancing railways was to prove that they could be made paying institutions, without state aid, if they could be assured of reasonably just treatment from state legislatures.

The roads which depended upon their own resources from the outset were relieved of embarrassing obligations, and, as a rule, all the early railways which were started on a sound basis, judiciously located, well managed, and which were not subjected to peculiar misfortunes, became finally successful, although the outlook at the end of the fourth decade was by no means encouraging. Charles Ellet, jr., in a work published shortly after 1840, in commenting upon the railways then completed, and in course of construction or extension, said that "some few have thus far sustained themselves, and distributed considerable dividends. The receipts of some others are sufficient to keep them in repair, and pay the interest on the loans incurred for their construction; but of the balance, having an aggregate length of some two thousand miles, the capitals may be regarded as positively sunk, and many of the companies as insolvent." He contended that a principal cause of the failures was a disproportion between the character of the works completed and the labors to be performed, and said that "they make costly roads, build expensive superstructures, rear extravagant edifices to contain their cars and engines, run heavy locomotives, and use carriages almost as capacious as dwelling houses, to carry as many passengers as could, without much inconvenience, be drawn in a hand-cart. If railroads do not sustain themselves, it is not because they are railroads, but because great roads have been constructed where little ones only are required. . . . The power contrived to turn a grist mill would make but small dividends if applied to turn a churn."

In a number of instances where state aid was of vital consequence, and where political or partisan considerations, and special deference to the views and designs of men who represented state governments, deeply affected practical management, the general results through a series of years were unsatisfactory. There were necessarily many secret proceedings in connection with the construction and operation of all the state works, whether canals or railways, and if the veil could be lifted which hides the real nature of some of the transactions of by-gone eras, it would be easier to explain why extensive state supervision, control, or interference created obstacles to the complete success of some of the promising early lines. It is difficult to find any one who was actually familiar with the practical operation of state works, who does not, when questioned in regard to them, either speak in terms of contempt or disparagement, or shrug his shoulders, and say that partisan considerations were paramount in some important affairs.

PHYSICAL CHARACTERISTICS.

As a railway is an embodiment of engineering and mechanical science applied to land transportation, it follows that its efficiency depends largely upon the degree or amount of skill applied to the service of any particular line or system. The entire combination of expedients is the outgrowth of centuries of scientific inquiry, ingenious investigations, and expensive practical tests. In early railway construction the knowledge relating to many details was comparatively limited, and in numerous cases lack of means prevented the adoption of the best methods that had been suggested. There was, besides, a great scarcity of trained assistants and of useful mechanical appliances, as well as of capital. The railway was but imperfectly understood, even by those who were best informed in 1830, and for some years later. One of the ablest and most celebrated of the civil engineers who entered into useful and prolonged service at an early day, said to the writer that he looked back with amazement, not unmingled with consternation, at the density of his own ignorance when he first began to assume heavy responsibilities. The pioneers have recounted many incidents illustrative of the deficiencies and drawbacks under which they labored. Strictly speaking there were no railway civil engineers, and no thoroughly competent representatives of dozens of distinct and complicated pursuits and professions which have since been developed, and which each require elaborate special training. The entire profession of civil engineering is of comparatively modern origin, and in the United States when railway construction commenced, two of the principal directions in which reliable assistants were sought and found were among men who had gained experience in locating canals, or men skilled as military engineers, either through instruction gained at West Point, or connection with various descriptions of governmental works. The canal operations which had preceded railway construction were of great service in training civil engineers and contractors; and a custom adopted of permitting officers of the United States army to temporarily enter into the service of railway companies without forfeiting their positions, materially increased the supply of available talent of a high order. Training as land surveyors also proved useful, and the American faculty of rapidly becoming expert in new fields of effort, helped materially to advance raw recruits into useful leaders. But for some time there was a great scarcity even of instruments and implements which would now be considered indispensable, as well as of thoroughly-trained men adapted to all intricate or difficult branches of railway construction and operation. From the outset, and largely up to the present day, one emergency or requirement after another was developed, which could only be fully met by means or measures for which there was no clearly defined precedent, and railway men of all grades were subjected, to an immense extent, to the necessity of learning their most valuable lessons in the stern school of rugged experience.

So far as theories had been developed, they were often more likely to be fallacious than correct. A notable instance of this is furnished by the title given to the main track and appurtenances. It is styled

A PERMANENT WAY,

partly in harmony with the idea that the structure would, by the free use of stone and iron, be imperishable. Experience soon demonstrated that of all descriptions of roads ever constructed, railways exceed all others in exacting requirements for incessant supervision and constant repairs. In one of the frequent legislative investigations of modern periods, a manager of an important western railway was told that his company was spending entirely too much money in keeping its road-bed in order, and that its patrons were unnecessarily subjected to onerous charges for this purpose. He replied that constant endeavors were made to keep down such expenses. He was then asked what would be the result if these expenses were very greatly reduced, to which query he replied that in a comparatively short time they would have no railway.

Another prominent idea, which has proved to be erroneous, but which was probably founded on previous experience with the turnpikes that were seriously injured or worn out by heavy wagons, was that it was very desirable that

LOCOMOTIVES AND CARS SHOULD BE AS LIGHT AS POSSIBLE.

It was only by slow degrees that advances were made in increasing the weight of rolling stock, but they have been so steady and continuous on every progressive line that they form a leading feature of new developments. At the outset, as in all subsequent stages, conflicting views, variations in amount of available capital, or the requirements of anticipated traffic, and other causes, led to the adoption of diverse mechanical systems, but all were more or less imperfect to an extent which can scarcely be appreciated by those whose conceptions of a railway are based on familiarity with first-class lines of the present day. For such ideals, tinder-box cars, puny locomotives, strap rails, and pine-board stations, with their natural accompaniments, must be substituted by those who want to form correct impressions of primitive lines.

DIFFERENT PLANS OF CONSTRUCTION

were tried on different roads, and frequently on different sections of the same road.

The highest state of development is probably represented by the best style of construction used on the Philadelphia and Columbia Railway, inasmuch as it was built by the state of Pennsylvania, and suffered less from impecuniosity, at the time of construction, than any contemporaneous enterprise. Of the tracks of this line, which was completed in 1834, and portions of which were opened for travel in 1832, Mr. W. Hasell Wilson, who was employed as one of the assistant engineers in surveying and constructing it, in his instructive notes on the Internal Improvements of Pennsylvania, says:—

"The length of the road (which had a double track) being $81\frac{6}{10}$ miles, there were $163\frac{2}{10}$ miles of single track, exclusive of sidings and crossings, of which 6 miles were laid with granite sills, plated with flat iron bars, 2½ inches in width by five-eighths of an inch in thickness; 18 miles with wooden string pieces plated in a similar manner; 2 miles with stone blocks and edge rails, having stone sills extending across the track at intervals of 15 feet; and $137\frac{2}{10}$ miles with stone blocks and edge rails, having wooden cross-ties intermediate, except on some of the embankments, where the edge rails were secured to cross-ties supported on longitudinal mud-sills. The English gauge of 4 feet 8½ inches was adopted for this road, and the tracks were placed 4 feet 6 inches apart. The granite sill track, which was similar to that laid on the eastern portion of the Baltimore and Ohio Railroad, and in regard to the permanency and efficiency of which great expectations had been formed, proved an entire failure. Although the sills were bedded on a stratum of broken stone one foot in depth well rammed, it was found impracticable to keep them either to an even surface or to gauge, and after a very short period of use, the iron bars began to work loose, curling up at the ends and forming what were termed 'snake heads.' The wooden track was also liable to the defect last mentioned, and as the timber soon commenced to decay, it became unsafe, especially for locomotives. In the course of a few years all of the flat bar track was replaced by T rails laid upon cross-ties. The edge rails, of which the greater portion of the road superstructure was formed, were rolled of the Wigan pattern, three and a half inches in depth, with the bottom and top surfaces parallel, weighing 41¼ pounds per yard. Cast-iron chairs of 15 pounds weight, were secured to the blocks or ties placed three feet apart, and the rails secured in the chairs by wrought-iron wedges, one on each side. The rails were at first ordered in lengths of 15 feet for straight lines, and 9 feet for curves, under the supposition that they would be too rigid to adapt themselves to a curve; but it was very soon discovered that they could without difficulty be forced into curved lines, and that the longer the rail the more easily this could be effected; consequently the 15-feet rails were taken for the curves, and the 9-feet rails made use of on straight lines. Subsequently the rails were all procured in lengths of 18 feet, and placed so as to break joint, with a cross-tie every 9 feet. The rails, which were procured from the Ebbw Vale Iron Works in Wales, cost upon the wharf at Philadelphia prices ranging from $44½ to $50½ per ton. The iron was of such excellent quality that the old rails remaining after the road came into possession of the Pennsylvania Railroad Company in the year 1857, was rerolled into rods for blacksmith purposes.

As the road was intended to be operated by horse power, and so used for several years, the space between the rails of each track was filled in with broken stone or gravel to form a horse path."

Of the method employed in

CONSTRUCTING THE PORTAGE RAILROAD,

which was also a work of the state of Pennsylvania, commenced in 1831, and opened in 1834, to form a connecting link between canals east and west of the crest of the Allegheny mountains, Mr. Solomon W. Roberts, who was one of the engineers, says:—

"The laying of the first track and turnouts, with a double track on the inclined planes, was contracted for on the 11th of April, 1832. The rails used weighed about forty pounds per lineal yard, and they were rolled in Great Britain. The hauling of them in wagons from Huntingdon, on the Juniata, was a laborious work. The rails were supported by cast-iron chairs, weighing about thirteen pounds each, the chairs being placed 3 feet apart from centre to centre, with a wrought-iron wedge in each chair. In most cases these chairs rested upon, and were bolted to, blocks of sandstone, containing 3½ cubic feet each, and imbedded in broken stone. These stone blocks were required to be 2 feet long, 21 inches wide and 12 inches deep. They cost about 53 cents each. On high embankments a timber foundation was used, with cross-ties and mud sills, which stood much better than the stone blocks. On the inclined planes, which were to be worked by means of ropes, flat bar-rails were laid upon string-pieces of timber.

Great care was taken in the drainage of the road-bed, and a large number of culverts and drains were built, there being 159 passages for water under the railroad. It was found, by experience, that the track must be tied across with cross-ties, or it could not be kept from spreading, and many such ties were put in between the stone blocks. The attempt to construct a permanent railroad track, containing no perishable material, was, in this case, a failure. We were striving to build a great public work to endure for generations, and, as it turned out, it was superseded by something better in about twenty years."

Jonathan Knight, chief engineer of the Baltimore and Ohio, in one of his publications in 1832, referred to the Columbia and Philadelphia Railroad as being built on the English plan, laid with heavy English rail, "upon cast-iron chairs and stone blocks, and it also includes inclined planes and their machinery, and other very expensive work, and especially of bridges, having to traverse the country across the streams. This railway is estimated at $28,173 per mile. The construction is of the most expensive character, and it has been planned with a view to great permanency, and for the use of heavy locomotive engines."

Of the plan first tried on the

BALTIMORE AND OHIO,

a report on railways made by a committee of the New York legislature in 1832, said:—

"The most approved method of constructing railways is on the plan adopted by the Baltimore and Ohio Railroad Company. A line of road is first graded, free from short curves, and as nearly level as possible. A small trench is then formed for each track, which is filled with rubble stone, on which are laid blocks of granite or other suitable stone (in the place of wood), which will square about one foot, and of as great length as can be obtained. The upper end and inner surfaces of each track are dressed perfectly even, as well as the ends of the blocks at their joinings. Bars, or plates of wrought iron, near an inch in thickness, are then laid upon these blocks or rails, in a line with the inner surfaces, and fastened to the stone with iron bolts or rivets, entering about four inches in holes fitted to receive them, and at a distance of about 18 inches. The distance between the two tracks, for the wheels, should be about five feet."

As on most other important roads, various modes of construction were adopted on the Baltimore and Ohio. In addition to the granite-sill method, six miles of single track were composed of stone blocks and wooden string pieces, and a considerable part of the line rested on wooden sleepers (or ties).

EARLY RAILS, SILLS, AND STONE BLOCKS.

DETAILED DESCRIPTIONS OF THE METHODS USED ON THE PHILADELPHIA AND COLUMBIA RAILROAD.

THE exact nature and cost of the methods adopted on the Philadelphia and Columbia Railroad are shown by the following data extracted from a note-book in which Mr. W. Hasell Wilson commenced writing, in 1831, such information as he considered valuable, while he was acting as principal assistant engineer on that road, under the direction of his father, Major John Wilson, chief engineer:—

Description and Estimate of Granite Railway, as Laid on the Columbia and Philadelphia Railway.

SILLS.—The sills are in lengths of not less than three feet; the size, one foot square, or containing not less than a square foot in the cross section, none, however, being less than eight inches in depth; the shape as nearly square as possible; the bed and upper surface, particularly, ought to be parallel. The upper surface is dressed for about five or six inches, to afford a smooth bearing for the iron. That part of the sill outside of the iron is reduced to the same level, but not so smoothly. The ends of the sills are dressed square, so as to be in contact for at least three inches in depth below the iron, and for six inches across the stone, exclusive of the chamfering.

BROKEN STONE.—The broken stone, the particles of which must not be larger than a cube of two inches, are to be kept clear from earth, clay, or other material.

TRENCHES.—The trenches are not less than two feet in width, and twenty-two inches in depth, below the top of the sill, except where the stone sill is wider than one foot, and where rock occurs in the trench. In the former case, the trench is made of such width as to admit of four inches of broken stone on each side of the sill; in the latter, the depth will be such as to allow four inches of broken stone under the sill.

LAYING.—The broken stone are placed in layers of three inches, each layer well compacted with a heavy rammer. The sills are then laid, and bedded with a heavy rammer.

THE HOLES are then drilled to correspond with the holes on the bars, and to suit the width and position of the track, not less than three and a half inches in depth, and five-eighths in diameter. No hole is drilled within three inches of the end of a sill. The plugs are of seasoned locust, fitting the hole exactly, but not requiring much driving. The bar is then spiked on, and the inner edge of the sill chamfered off, in width two inches, and in depth one inch and a half.

THE HORSE PATH is filled in, and the earth sloped from the back of the sills, to turn off the water collecting on the surface.

THE IRON BARS are in lengths of fifteen feet, two and a quarter inches in width, and five-eighths of an inch in thickness. The spikes are three and a half inches in length, and three-eighths of an inch square, the heads fitting the countersink of the bar.

Estimate for One Mile of the Granite Railway, as Completed by Robinson, Carr & Co.

23 tons of flat-iron bars, at $41	$943 00
900 pounds of spikes, at 10 cents	90 00
Hauling 24 tons, at $2	48 00
10,560 feet of granite sills, at 37½ cents	3,950 00
Extra hauling of sills	138 00
10,560 feet laid (including broken stone), at 33 cents	3,484 80
Removing earth	150 00
Crossings	150 00
320 rods of horse path, at $1.32	422 40
Average of extra work, building drains, grading, and dressing road	803 00
	$10,179 20

Description and Estimate of a Wooden Railway.

SILLS.—The sills are chestnut, white oak, or chestnut oak, seven and a half feet in length, and of such size as to square seven inches; dressed flat on the under side, and notched on the upper.

TRENCHES.—The trenches are four feet apart, from centre to centre, one foot in width, sixteen in depth (making twenty-four inches to top of wooden rail), and eight feet in length.

RAIL.—The wooden rail is yellow pine, six inches square. The keys are of white oak or yellow pine, one foot in length, two inches in height, and one inch and a half thick, tapering to three-quarters.

In notching the sills for the rail, there must be left at least three inches of a bearing under the rail.

Estimate for One Mile of Wooden Railway as Completed.

23 tons of flat iron bars, at $41	$943 00
900 pounds of spikes, at 10 cents	90 00
710 splicing plates, at 3½ cents	24 85
Hauling iron	96 00
37 thousand feet of scantling 6×6, at $29	1,073 00
1,320 sills, at 50 cents	660 00
1,334 perches of broken stone, at $1.12½	1,500 75
320 rods laid, at $2.26	723 20
320 rods horse path covered, at 50 cents	160 00
Removing earth	301 00
Extra work	32 68
	$5,604 48

Edge Rails on Stone Blocks and Stone Sills, as Laid Between Broad Street and Schuylkill River.

BLOCKS.—The blocks are of granite, twenty inches in length, sixteen in width, and twelve in depth; depth of holes, six inches; diameter, one inch.

SILLS.—The transverse sills are of granite, six and a half feet in length, and twelve inches square. These are placed at the joining of the bars, about fifteen feet from centre to centre.

TRENCHES.—The trenches are twenty-eight inches wide, and twenty-four inches deep (from the top of the block).

LAYING.—The broken stone are placed in layers of three inches, well rammed; the blocks and sills then laid, three feet apart from centre to centre. They are then drilled, the chairs fastened on, and the iron bars laid and keyed. The broken stone are now rammed around the blocks and sills, and the horse path filled in.

THE IRON is the same as that used on the Wigan railway, the rail weighing forty-one and a quarter pounds to the yard. Between the chair and block a piece of canvas is inserted (the size of the chair), soaked in tar.

Estimate for One Mile of Edge Rails on Stone Blocks and Sills, as Completed.

64$\frac{8}{10}$ tons of iron bars, at $41	$2,656 80
23$\frac{6}{10}$ tons of chairs, at $37	873 20
5 tons of bolts and wedges, at $109	545 00
93$\frac{4}{10}$ tons hauled, at $2	186 80
352 stone sills, at $3	1,056 00
2,816 stone blocks, at 65 cents	1,830 40
2,347 perches of broken stone, at $1.25	2,933 75
1,760 yards laid, at $1	1,760 00
Road crossings	606 00
404 cubic yards excavation, at 12½ cents	50 50
3,520 pieces of canvas, at 2 cents	70 40
	$12,568 85

Estimate for One Mile, Without Stone Sills, as Laid.

Iron, as above	$4,075 00
93$\frac{4}{10}$ tons hauled, at $3	280 20
3,520 stone blocks, at 62½ cents	2,200 00
2,067 perches of broken stone, at $1.25	2,583 75
1,760 yards laid, at 75 cents	1,320 00
Road crossings	195 78
Removing earth	202 75
Canvas	70 40
	$10,927 88

Description and Estimate of Edge Rails on Stone Blocks and Locust Sills, as Laid Between Columbia and the Intersection of the West Chester Railway.

BLOCKS.—Granite, limestone, or sandstone, 22 in.×16 in.×12 in.

SILLS.—Locust 7½ feet long, 6×8 inches, laid 15 feet apart, and on the flat side; in the curves they are placed 9 feet apart. The rails are not joined on the sills, but on the nearest blocks, but not opposite. A cross trench is dug for each sill, and filled with broken stone, which, on the embankments, is continued out to the edge of the bank, thereby serving as a drain. Between the rails, the space is filled up with earth to a level with the top of the blocks. The holes in the blocks are drilled six inches in depth, and one and a half inches in diameter, then plugged with red cedar, which is previously bored through the centre, half an inch in diameter, the bolt being five-eighths.

Estimate for One Mile of Edge Rails on Stone Blocks and Locust Sills; Prices Averaged from Contracts Completed.

64$\frac{8}{10}$ tons of edge rails, at $50	$3,240 00
23$\frac{6}{10}$ tons of chairs, at $39	920 40
5 tons of bolts and wedges, at $97	485 00
93$\frac{4}{10}$ tons hauled, at $8	747 20
352 locust sills, at $1.80	633 60
2,816 stone blocks, at 90 cents	2,534 40
2,000 perches of broken stone, at $1.25	2,500 00
1,760 yards of workmanship, at 85 cents	1,496 00
Six road and farm crossings, at $13	78 00
2,816 pieces canvas, at 2 cents	56 32
1,800 cubic yards excavation, at 15 cents	270 00
1,400 cubic yards embankment, at 20 cents	280 00
	$13,240 92

Description and Estimate of Edge Rails on Wooden Cross Sills and Bearing Timbers.

THE BEARING TIMBERS are white oak, 10×12 inches, and in lengths of not less than 20 feet, laid edgewise, and notched down two inches, every three feet, to receive the cross sills.

At the joinings of these timbers, there is a tenon 4 inches thick, and the whole width of the timber, laying horizontally across the centre of the stick, and projecting six inches with a mortice (to fit) on the opposite stick, secured by a wooden pin. The sills are 7½ feet long, 6×8 inches, of white oak, or chestnut, except at intervals of 15 feet on the straight lines and 9 feet on the curves, where they are of locust. They are laid on the flat side, and secured to the bearing timbers by wooden keys.

Estimate for One Mile of Edge Rails Upon Bearing Timbers and Sills, with Locust Sills at Every Fifteen Feet.

64$\frac{8}{10}$ tons of edge rails, at $50	$3,240 00
23$\frac{6}{10}$ tons of chairs, at $39	920 40
5 tons of bolts and wedges, at $97	485 00
93$\frac{4}{10}$ tons hauled, at $8	747 20
352 locust sills, at $1.80	633 60
1,408 white oak sills, at 80 cents	1,126 40
10,771 feet lineal of white oak timber, at 25 cents	2,692 75
960 perches of broken stone, at $1.25	1,200 00
1,760 yards of workmanship, at 70 cents	1,232 00
Six road and farm crossings, at $13	78 00
1,800 cubic yards excavation, at 15 cents	270 00
1,400 cubic yards embankment, at 20 cents	280 00
	$12,905 35

It will be seen that the estimates given above relate to six styles or variations in construction. The word sills is sometimes used to indicate wood or stone which performed functions similar to those now entrusted to ties, especially when they are called cross sills, and sometimes to indicate a continuous foundation on which rails were laid; and the relatively small number of cross sills (or ties) used, indicates that at the outset the danger of the tracks spreading was not fully realized. It is somewhat surprising, too, to note how nearly one of the systems adopted approximated to modern methods in the matter of creating a foundation of broken stone, and using wooden cross sills or ties.

"SNAKE HEADS."

A large proportion of the early railway tracks represented close imitations of a style adopted by early coal roads, consisting of bars of iron spiked on stringers of wood, and this style was so extensively employed, and continued in use in some sections for such a protracted period, that "snake heads" became one of the recognized and most important of early railway perils. This term was suggested by the liability of the iron bar to become loosened from its fastenings as a train moved over it, and it would sometimes suddenly turn upward with sufficient force to pierce the bottom of cars, and occasionally injure passengers, or throw a train from the track. As it was not until near the middle of the fifth decade of the nineteenth century that iron rails were manufactured in this country, except a few cast-iron rails and flat bars, it was necessary to import all rolled-iron rails that were used here, and this operation, together with the large amount of iron required even by the edge rails then used, necessitated a greater expenditure than could be afforded by many of the earlier companies.

Horatio Allen, chief engineer of the South Carolina Railroad, which had 10 miles in operation in 1830, and increased this mileage by 52 miles in 1832, and 75 miles in 1833, and which for a time enjoyed the distinction of being the longest continuous railway in the United States, and the first to use a locomotive of American construction, says of this road, that "it was of the age of wooden rails capped with iron. Confidence and capital had not yet reached the growth to make an iron track of the most modest weight per yard a possibility, and steel rails were as unthought of as the telegraph. On timber rails, 6-inch×12-inch section, iron bars 2½-inch×½-inch were spiked. The wood was the southern pine, the hard, resinous surface of which was as suitable for the iron bars as wood could be."

The South Carolina was one of the first companies to substitute edge or iron rails for iron bars or plates over its entire line, as this course was adopted a few years after the completion of the road. The desire of engineers and managers to secure such an advance was very general, as they fully appreciated its importance, and explained the advantages derived from its use in the way of saving operating expenses, but the difference in cost of construction, when comparatively heavy edge rails were used, was at one time estimated at about $6,000 per mile, and this outlay was too great to be borne by most of the early companies. The result was that flat bars continued to furnish the iron for many tracks during a protracted period. In 1839 all the New York railways, except the Long Island, used flat bars. All the railways in Pennsylvania used iron plates or bars, varying in dimensions from 1½×⅜, on short early mine roads, to 2¼×⅝, except the state railways; the Norristown line, which at that time used 40-pound rail; the Philadelphia and Reading, which used 45-pound rail; the York and Wrightsville; Buck Mountain; Little Schuylkill and Susquehanna; Beaver Meadow extension; and West Branch, a road leading from Schuylkill Haven to Mine Hill. All the railways of Virginia, North and South Carolina, Georgia, and Florida used flat bars, varying in dimensions from 2×½ to 2½×¾, except the South Carolina, and portions of the Georgia and Central roads, of Georgia. All the railways of Alabama, Louisiana, Mississippi, Tennessee, and Kentucky used flat bars, except the Pontchartrain, of New Orleans; the Mississippi; the Vicksburg and Jackson, and the Grand Gulf and Port Gibson. All the railways of the Western states used iron bars or plates except the Madison and Indianapolis.

WOODEN "RAILS," STRING PIECES, OR STRINGERS.

In a large proportion of the very early railroads wood was extensively used of such shapes and patterns that, in the railway language of that day, it was generally called "rails." Some of the primitive lines did not even have these wooden rails covered with flat iron bars, and they were called wooden rail-roads, a term which was also frequently applied to the forms of construction in which the wooden rail was plated with iron bars. Timber rails were an article of commerce. Considerable quantities were sent from South Carolina and North Carolina to be used on the early railways in Pennsylvania. Their dimensions were sometimes 5×9; and sometimes 5 inches wide and 7 deep, and they were usually plated with flat iron bars. The dimensions of these bars was frequently a matter of considerable importance. When the bars were narrow and thin it was found that under the pressure of heavy loads, the bars would bend and sink into the wooden rail. To obviate this effect, a small sheet of zinc was sometimes placed beneath the ends of the iron rails. The wooden rails, string pieces, or stringers, rested frequently on wooden ties which were then called sleepers.

The following description of an early road of a class which, while it did not represent the highest rank, was very much better than a number of inferior roads, was published in 1832, in the notes appended to Mr. G. W. Smith's American edition of Wood's Treatise on Railroads. The account was furnished by Messrs. Kughler and Dundas:—

"The Mine Hill and Schuylkill Haven Railroad was begun in June, 1829, and finished, the main line, in June, 1830, and the remainder in June, 1831. The main line commences at Schuylkill Haven, and extends 10½ miles along the west branch of the river Schuylkill, through the Mine Hill Gap. At the fork of this branch with the west-west branch of the river, 6 miles from Schuylkill Haven, a branch of the railroad extends along the last-mentioned arm of the river, 3½ miles of a double track, and one mile of a single track, but graded for a double track, making 14 miles of a double track, and one of a single, or 15 miles in the whole. The company have disbursed for all expenses, in completing this work, $181,165. The width of the track is 4 feet 8½ inches. The *sleepers* (white oak) are 4 feet apart, from centre to centre, and average 10×8 inches. The *wooden rails* (white oak) are 4×7 inches. The iron rails are 1½ inches wide by half an inch thick. The curves are in no instance of a radius less than 400 feet, but generally 500 feet. The grades do not exceed 30 feet to the mile, except on two inclined planes, the first of which is 80 feet to the mile; the second 150 feet to the mile. The sleepers rest on stone rubble work, in three parallel lines, from one end of the road to the other. There are 50 bridges, each of 28-feet span. The highest embankment is 21 feet, and the deepest excavation 31 feet. There are 12 culverts, and several minor bridges and drains.

COST.

Sleepers, 40,000 in number	$8,000
Rails, 800,000 feet, at $12 (per thousand)	9,600
Bridges, making and putting up fifty, 28 feet in the clear, 32 feet long, at $80	4,000
Iron for rails	20,000
Laying the sleepers and rails, and fixing the iron on and dressing	15,000
Filling the horse path with stone	3,500
Making and filling the trenches with stone, 35 miles, 18 inches deep and wide	6,500
The stone work, abutments, wing walls, and piers of the bridges, with about one mile of slope wall	25,000
Grading double track, 15 miles, including powder, tools, and wagons	75,000
Engineering salaries—interest and incidentals	13,015
Total	$181,615

This is as near the actual cost as can be obtained."

It will be perceived that in this statement the wood on which the iron rested was designated "rails," while the iron with which they were plated was described as "iron for rails."

ORIGIN OF THE T-RAIL.

The imperfections of the snake-head rails and of the early English substitutes for them suggested to an American, Mr. Robert L. Stevens, of Hoboken, who was the son of Col. John

Stevens, the prominent early American advocate of railways, an improvement in rail construction which is the progenitor of the present T-rail. It is stated that when Mr. Robert L. Stevens, who was actively identified with the construction of the Camden and Amboy Railroad, "was on the ship, on his way to Europe to order the 'John Bull,' in 1830, he devoted a considerable amount of time to whittling out cross-sections of what he thought would be a good kind of iron rails to lay on the railroad. The best rail then known was the T-rail without any base. This style had been adopted by all the most important roads in Europe. Owing to its peculiar shape, it required a chair on every cross-tie or stone block, as the case might be. Stevens was the first man to design the rail which he termed the H-rail—in other words, a rail with a base which could be spiked with 'hook-headed' spikes directly to the bearing." Rails made in accordance with this pattern were laid down upon the Camden and Amboy when it was first constructed, and methods were also adopted for joining or splicing the rails which represent a great advance on the systems then generally prevailing. Of these rails a report of the company says that they were of the I form invented by Mr. Stevens, 3½ inches high, 2½ inches on the upper running surface, and 3½ inches in width on its base, weighing 42 pounds to the yard.

The writer has been credibly informed that Mr. Stevens encountered great difficulty in his efforts to induce a British rail mill to make rails of the improved pattern he had devised. He was obliged to assume the whole responsibility of the scheme, to pay all the extra expenses, and to give heavy security to guard the works against all description of damages that could possibly be inflicted on the rail works by this innovation, which was evidently regarded as dangerous, or at least highly imprudent, and likely to prove disastrous to all concerned. The supposed grounds for such adverse views must have made a deep impression, for a long period elapsed before the use of T-rails became approximately universal, although some companies adopted the T-rail a few years after it was first used on the Camden and Amboy. The T-rail became widely known as the Vignoles rail, rather than the Stevens rail, because a European engineer, Mr. C. B. Vignoles, hastened its introduction on European railways, using them on English roads during the progress of construction to an extent that gave to them the title of contractors' rails.

A recognition of the usefulness of the improvement must have been comparatively rapid, because by or before 1840 the H- or T-rail was in use on all or portions of the following American lines, viz.: Camden and Amboy; Philadelphia and Reading; Philadelphia, Wilmington and Baltimore; Long Island; portions of the Philadelphia and Columbia Railroad, on which flat, plate, or bar-iron rails had originally been laid; on important New England roads, including the second track of the Boston and Lowell, Boston and Worcester, Boston and Providence, Providence and Stonington; New Castle and Frenchtown; Washington branch of the Baltimore and Ohio, and portions of the Georgia Railroad.

In a description of the Camden and Amboy Railroad, contained in Mr. George W. Smith's appendix to Wood's Treatise on Railroads, and published in 1832, the following reference is made to the T- or H-rails used: "The rails are of rolled iron, 16 feet long, 2¼ inches wide on the top, 3¼ inches at the bottom, and 3½ deep; the neck half-inch thick. The weight is 209 pounds = $39\frac{3}{16}$ pounds per yard. They are secured by clamps of iron, riveted at the extremity of each bar. The rails are attached to the stone blocks and sleepers by means of nails or pins at the sides, driven into wooden plugs. *Chairs are dispensed with.*"

The following interesting letter relating to this subject is published in Mr. J. M. Swank's census report of 1880, on iron and steel manufactures, the writer of the letter being a nephew of Mr. Robert L. Stevens:—

"Hoboken, New Jersey, May 31, 1881.

Dear Sir: In answer to your letter of the 27th instant I will say that I have always believed that Robert L. Stevens was the inventor of what is called the T-rail, and also of the method of fastening it by spikes, and I have never known his right to the invention questioned.

The rail of the Liverpool and Manchester Railroad, on its opening, in September, 1830, was of wrought iron, divided into fish-bellied sections, each section being supported by a cast-iron chair, to which it was secured by a wooden wedge. The form was derived from the old cast-iron fish-bellied tram rail, cast in single sections, each about 36 inches long. This wrought-iron rail was afterwards improved by making its bottom straight uniformly throughout its length.

Mr. Stevens' invention consisted in adding the broad flange on the bottom, with a base sufficient to carry the load, and shaped so that it could be secured to the wood below it by spikes with hooked heads; thus dispensing with the cast-iron chair, and making the rail and its fastenings such as it now is in common use. In the year 1836 and frequently afterwards he spoke to me about his invention of this rail, and told me that in London, after unsuccessful applications elsewhere in England, shortly after the opening of the Liverpool and Manchester Railroad, he had applied to Mr. Guest, a member of Parliament, who had large rolling mills in Wales, to take a contract to make his rail for the Camden and Amboy Railroad, of which he was the chief engineer; that Mr. Guest wished to take the contract, but considered that it would be impracticable to roll the rail straight; that, finally, Mr. Guest agreed to go to Wales with him and make a trial; that great difficulty was at first experienced, as the rails coming from the rolls curled like snakes, and distorted in every imaginable way; that, by perseverance, the rail was finally successfully rolled; and that Mr. Guest took the contract. The Camden and Amboy Railroad, laid with this rail, was opened October 9th, 1832, two years after the opening of the Liverpool and Manchester Railroad. Of this I was a witness.

This rail, long known as the old Camden and Amboy rail, differed but little, either in shape or proportions, from the T-rail now in common use, but weighed only 36 pounds to the yard. For the next six or eight years after the opening of the Camden and Amboy Railroad this rail was but little used here or abroad, nearly all the roads built in the United States using the flat iron bar, about 2½ inches by ⅝ inch, nailed to wooden rails, and the English continuing to use the chair and wedge.

My uncle always regretted that he had not patented his invention. He mentioned to me, upwards of forty years ago, that when advised by his friend, Mr. F. B. Ogden, the American consul at Liverpool, who was familiar with the circumstances of his invention, to patent it, he found that it was too late, and that his invention had become public property.

Yours, truly, Francis B. Stevens."

DIVERSITIES IN PERMANENT WAY.

In addition to the plans of construction heretofore referred to, various modifications were adopted in different localities, the most important of which were rendered possible by the T- or H-rail. The Boston and Lowell used, in its first track, edge rails which were not parallel, but of the fish-bellied pattern, *i. e.*, their bottoms were slighly curved, as the body of a fish is curved, so that the amount of iron used was greatest at the points most distant from the rail joints. Where the H- or T-rail was used numerous chairs ceased to be indispensable, as this rail, unlike the edge rail, was self-supporting, and the use of chairs was generally confined to places where the rails were united. A greater number of sleepers or ties than had originally been considered desirable were put down in the tracks of some roads. On the Boston and Providence sleepers of white cedar were laid down 3 feet apart from centre to centre. They were seven feet long and six inches thick, and rested on broader sills of hemlock. On the Philadelphia and Reading, on which H-rails, weighing 45½ pounds per yard were used, the rails were laid upon white oak sleepers, or cross-ties, seven feet in length, and of a uniform depth or thickness of seven inches. They were laid 3½ feet apart from centre to centre, and each sleeper was laid upon a prism of broken stone, deposited in a trench 14 inches deep, 12 inches wide, and 9 feet long across the line of the track. At the rail joints the rails rested upon cast-iron chairs, let into the sleepers by means of notches cut for that purpose. The chair was six inches square at its lower surface, where it was five-eighths of an inch in thickness. There were bolts, with nut screws attached, to hold the ends of the two rails to the chair. The bolt and nut weighed 7 ounces, and the chair 10½ pounds. The chairs, and the rails, at the points where they rested on sleepers, were spiked down, with spikes six inches in length, with stems three-fourths by five-eighths of an inch. In a mile of track of the Philadelphia and Reading, built in accordance with these requirements, there were 563 bars of iron, weighing 71 tons; 563 chairs, weighing 5,910 pounds; 7,882 spikes, weighing 4,524 pounds; 1,126 screw bolts and nuts, weighing 481 pounds, and 1,689 sleepers. The entire cost of the single track as laid, was reported to be $7,617 per mile. As the road was intended, from the outset, for exceptionally heavy traffic, it was much more substantially built, in every respect, than was usual at the time of its construction, and the rails proved to be very serviceable.

On portions of the Western (of Massachusetts), which were being constructed about 1840, a mode was adopted which differs in some important respects from any of those heretofore described. The rails were of the U or bridge pattern. A contemporaneous description says: "The rails are of wrought iron, rolled in lengths of fifteen feet, and made hollow. The top is two inches wide, base six inches, and height one inch and three-quarters. Holes are punctured in the flanges on both sides, about eighteen inches apart, to secure the rail (without chairs) to the sleepers, by means of screws eight inches long. To prevent the sleepers from spreading, there are, at every fifteen feet, iron ties across the railway, spiked down at each end of the sleepers."

In this description the term sleepers was used to designate "longitudinal, continuous sleepers of Memal timber kyanized, thirteen or fourteen inches wide, by six and a half or seven inches thick, which are firmly bedded on the ground, previously made even and well rammed. On the top of the sleepers are laid the rails." Another feature was an effort to give the outer edge of the rail a slightly higher altitude than the inner edge, for the purpose of making the surface of the rail correspond as closely as possible with the conical shape of the car wheels. Other railways endeavored to accomplish that object at comparatively early periods, but the results were usually not satisfactory.

TUNNELS AND BRIDGES.

THE existence of mountains, and mountain ranges or spurs, in all the Atlantic states, which constituted such a serious barrier that during a considerable portion of each year they were often impassable, was an obvious fact, and where pioneer railways were so located and environed that summits could not be evaded by a circuitous route it was necessary that a choice should be made between very heavy cuts, tunneling, or ascending and descending relatively steep declivities either by the use of inclined planes or locomotives. The assistance obtained in solving such difficult problems from American improvements in the locomotive was of incalculable value. While tunnels had some earnest advocates, their great expense led at the outset to postponement in nearly all cases where any available substitute could be found. There was, however, a tunnel built on the Portage Railroad in 1832, which is said to be the first railroad tunnel in the United States. It passed through a spur of the Allegheny, and it was 901 feet in length, 20 feet wide, and 19 feet high within the arch, 150 feet at each end being arched with cut stone.

Mr. H. S. Drinker's elaborate work on tunneling, published in 1878, furnishes a list of nearly three hundred tunnels in the United States, with their length and date of construction. Only a comparatively small number were commenced or completed before 1840, but the railway tunnels of that era embrace, in addition to the Portage, the following:—

A tunnel built by the Baltimore and Ohio, named Doe Gully, located about sixty miles west of Harper's Ferry, for the purpose of avoiding a circuitous bend of the Potomac river. It was built in 1839–41. Its length was 1,207 feet, and its cost was $98,426. Another tunnel was built by the same company, at Harper's Ferry, in 1839–40, 86 feet in length, which cost $4,386. A tunnel built by the New York and Harlem, called "Old" Harlem Tunnel, in 1836–37, 844 feet in length. A tunnel built by the Harrisburg, Portsmouth, Mount Joy and Lancaster Railroad Company, on a line which now forms part of the Pennsylvania Railroad system, in 1835–38, named Elizabethtown, 900 feet in length. The Black Rock Tunnel, built by the Philadelphia and Reading Railroad Company, in 1835–37, near Phœnixville, 1,932 feet in length, which cost $178,992. The Flat Rock Tunnel, built by the same company, at Manayunk, in 1840, 937 feet in length. The Pulpit Rock Tunnel, built by the same company, in 1839–41, at Port Clinton, 1,637 feet in length, which cost $116,728. The Summit Tunnel, built by the Catawissa and Williamsport Railroad, at Summit Station, in 1838, 1,050 feet in length. The Sherman's Tunnel, built by the same company, in 1838, 377 feet in length.

THE BLACK ROCK TUNNEL.

It will be seen by the above list that the Black Rock tunnel, built by the Philadelphia and Reading Railroad Company, was the largest tunnel constructed during the fourth decade. It was the second of the American railway tunnels, being commenced soon after the completion of the Portage tunnel, and the first tunnel in this country on which shafts were sunk. The resident engineer was Mr. W. Hasell Wilson, and his note-book contains an interesting description of all the details connected with the construction, from which we extract the following statement:—

Final Estimate of Section 54. James Appleton, Contractor.

Rock excavation of tunnel, 21,713 yards, at $5.80	$125,935 40
Rock excavation of shafts, 881 yards, at 20 cents	17,620 00
Rock excavation of ends, 22,126 yards, at $1	22,126 00
Slate excavation of ends, 2,968 yards, at 25 cents	742 00
Embankment, 12,620 yards, at 16 cents	2,019 20
Vertical walling, 4,799 perches, at 80 cents	3,839 20
Masonry of drains, 122 perches, at $2	244 00
Masonry of end faces, 464 perches, at $6	2,784 00
Masonry of slope wall, 32 perches, at $1.50	48 00
Opening drain through tunnel	1,600 00
Clearing tow path (of adjacent canal) of material thrown down	1,114 00
Walling top of shafts	70 00
Fencing around south end of tunnel	55 55
Clearing centre line over hill	77 00
Ditching	32 20
Leveling along foot of vertical wall	18 70
Forming path through tunnel	12 20
Backing parapets at end faces	50 00
Timbering soft vein in tunnel	150 00
Clearing out slip in deep cut at north end	20 00
Removing stone thrown into canal	50 00
Patterns for arches	6 55
Laying drain at south end	60 00
Wood work of drain	20 00
Marble tablets	44 00
Constructing cribs in river to convey materials on	200 00
Damage to Garrigues' factory by blasting	54 21
	$178,992 21

RAILWAY BRIDGES AND VIADUCTS.

It was manifestly necessary to provide bridges for the passage of small streams, and even over streams of considerable width, which were not navigable, bridges were constructed; but over the early long bridges trains could only be moved at very low rates of speed, and over some of the navigable streams, now crossed by many trains daily, ferry-boat operations were continued for many years.

Stone bridge-building had been practiced for centuries, and a number of very durable stone bridges had been erected over minor streams during the turnpike era. The skill and available force they developed was pressed into railway service at points where financial and other considerations permitted. Of one of the early railway viaducts, built about 1832, which formed part of the Allegheny Portage Railroad, Mr. Solomon W. Roberts, in 1878, said:—

"The Horseshoe-bend, or Conemaugh viaduct, is still standing, and is used by the Pennsylvania Railroad Company as a part of its main line, and it is, I believe, almost the only structure of the old Portage Railroad now in use. It is a substantial and imposing piece of masonry, about seventy feet high, and with a semi-circular arch of eighty-feet span. The chief engineer had prepared a plan for a bridge of two arches, each of fifty-feet span, but afterwards adopted the plan of the present structure. It was designed, and its erection superintended, by me, and the work was done by an honest Scotch stone-mason, named John Durno, who was afterward killed by falling from another high bridge. The arch is three and a half feet thick at the springing line, and three feet at the crown. The arch stones are of light-colored sandstone, and the backing of silicious limestone, found near the spot. The sandstone was split from the erratic blocks, often of great size, which were found lying in the woods, on the surface of the ground. The contract price for the masonry was $4.20 per perch of twenty-five cubic feet, and the work was remarkably well done. The face stones were laid in mortar made from the silicious limestones, without the addition of any sand. The cost of the viaduct was about fifty-five thousand dollars, and by building it a lateral bend of about two miles was avoided. The embankment at the end of the viaduct was sixty-four feet high. Since that work was done, iron bridges have taken the place of such structures."

Of the bridges and viaducts on the Philadelphia and Columbia Railroad, Mr. W. Hasell Wilson, in his notes on Internal Improvements in Pennsylvania, says:—

"There were twenty-two railway bridges or viaducts, constructed with stone abutments and piers, surmounted by timber superstructure; and thirty-three overhead bridges for public and farm roads. The following were the most important structures:—

Schuylkill viaduct, having seven spans, the clear lengths of which between the piers were, two of 122 feet each, three of 135 feet each, and two of 137 feet each. The abutments and piers were constructed of coursed and hammer-dressed masonry, from the bottom of the foundations, which were on rock, with the exception of the western abutment and two adjacent piers, which were founded upon hard gravel. Five of the piers were in the river and required coffer dams; one of them stood in 26 feet depth of water. The wooden superstructure was 1,045 feet in length by 49 feet in width, with four trusses on a modification of the Burr plan, having a passage way of four feet in the middle for foot travelers, and one of 18½ feet on each side for railway and common road respectively. The height of the bridge floor above ordinary water line was 38 feet.

Valley Creek viaduct consisted of four spans of 130 feet each in clear, with a height from water to floor of 60 feet.

East Brandywine viaduct had four spans of 89 feet each in clear, with a height of 30 feet.

West Brandywine viaduct had a length of platform of 835 feet, divided into six spans, resting upon abutments and piers of coursed masonry. The railway tracks rested upon the upper chords of the trusses, at an elevation of 72 feet above the water of the creek.

Pequea viaduct was one span of 130 feet.

Mill Creek viaduct comprised four spans with a total length of 550 feet, and a height from water to floor of 40 feet.

Little Conestoga viaduct had a superstructure 804 feet in length, elevated 47 feet above the stream.

All of the above-named bridges were constructed according to a modification of the Burr plan.

The viaduct over Big Conestoga creek had a superstructure on the Town lattice plan, 1,412 feet in length, at an elevation of 60 feet above the water line. The spans were of various lengths, the longest being 120 feet.

The abutments and piers of all the viaducts, except those at the Schuylkill river and West Brandywine creek, were constructed of rubble masonry."

BRIDGE CROSSING THE SCHUYLKILL RIVER NEAR PETERS' ISLAND.

The most important of the bridges referred to above was that leading from the foot of the inclined plane, on the west bank of the Schuylkill, to the eastern side of that river, where a connection was formed with the railway leading to the junction of Broad and Callowhill streets, in Philadelphia. After being used as part of the state works from the time of its completion, in April, 1834, until the construction of a line leading to Market street, this bridge and its eastern rail connection were sold to the Philadelphia and Reading Railroad Company, and subsequently used by that company in facilitating the movement of passenger and miscellaneous freight trains from the Broad street depot of its main line. In August, 1886, the receivers of the Philadelphia and Reading obtained authority to replace this bridge with an iron structure, to be built by the Phœnix Iron Company. As stated above, the wooden superstructure, which rendered continuous service for more than fifty-two years, was built in accordance with a modification of the Burr plan, and this plan, intermingled with some modifications, furnished designs for a large proportion of the important wooden bridges of the period of its erection, as well as of the wooden bridges built across important streams in Pennsylvania by turnpike or bridge companies for some years previous to the commencement of the construction of important railways.

The Schuylkill bridge was designed by Major John Wilson, chief engineer of the Philadelphia and Columbia Railroad, and the construction was superintended by Mr. W. Hasell Wilson, principal assistant engineer. Mr. Frederick Erdman was the bridge inspector, a position for which he was well qualified by previous experience in the performance of similar duties for the Schuylkill Navigation Company. The contractors were Dodd, Bishop & Brittin. The width of the river at the point of location was about 850 feet, and at the eastern shore the river was about twenty-five feet deep. As the bridge possesses great historic interest in this and many other localities, on account of the important and prolonged service it has rendered, and as the methods pursued and the items of cost illustrate more fully than any other attainable data, particulars relating to important bridge building during the first half of the fourth decade, in this country, the following extracts from the note-book of Mr. W. Hasell Wilson, commenced in 1831, are appended:—

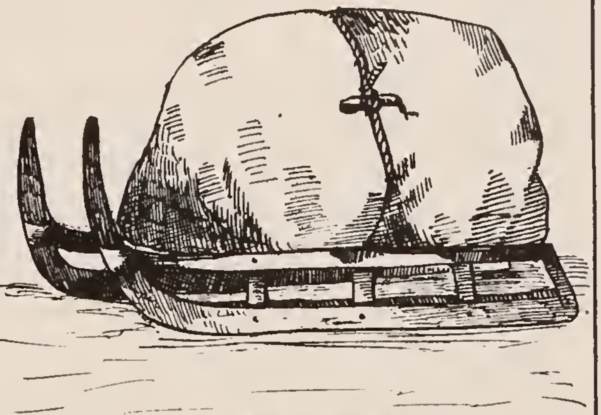
Specifications for the Bridge over Schuylkill River.

"The bridge is to stand on six piers and two abutments, which are to be founded on the solid rock, made perfectly level, and constructed of dressed rubble stone, not less than twelve inches in thickness, laid in courses. The stones are to be of the best quality and subject to the inspection of the engineer; they shall be hammer dressed, squared, and laid in full mortar, arranged in such manner as to form a system of headers and stretchers (the headers to be not less than three feet), the filling up to be of stones of the best quality, properly connected with bond stones.

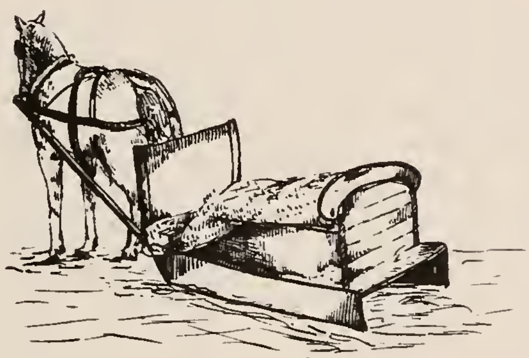
[Here follow a number of minute directions relating to the foundations of the piers, the piers, and abutment walls. The piers were to be 22 feet thick, and 63 feet 6 inches long at the base, exclusive of the angular points or heads, which were to extend from the foundations to high water mark.]

The construction of the wooden superstructure must be in strict conformity to the plan exhibited by the engineer, the contractor furnishing all materials, whether of wood or iron. The platform or floor to be supported by four wooden arches trussed and constructed as represented in the drawing, placed vertically on the piers and abutments, at such distances from each other as to admit of two passages of 18 feet 6 inches each in the clear, and one of 4 feet in the clear, between the arch pieces, which, together with the thickness of the said trusses, make the whole thickness of the bridge 49 feet 8 inches. The height of the truss from the bottom of the chord to the top of the plate is to be 17 feet. The king-posts are to be 10×20 inches above the shoulder, and 10×8 inches in the waist, except that part above the arch, which shall be large enough to saddle 2½ inches on the other arch pieces. The queen-posts to be of white pine, 10×15 inches above the shoulder, and below the step, and 10×9 inches in the waist, to saddle 2½ inches on the arch pieces, as heretofore described and as represented in the drawing No. 5. The carry braces to be of white pine, 9×10 inches. The stay braces of white pine 5×10 inches. The chords of white pine, 8×14 inches, and in such lengths as required by the bill of timber, furnished by the engineer. The

Primitive Sledge.

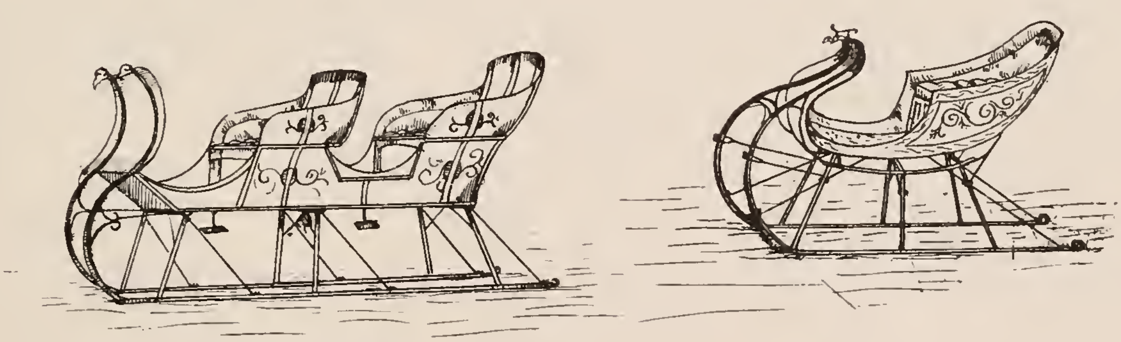


Mountain Sled.



Rural Jumper.

Wood Sled.



Modern Sleigh.

arches of white pine, 8×18 inches at the crown, 8×24 inches at the foot, placed on each side of the king- and queen-posts as represented in No. 5. The plates of white pine, 10×12 inches, the scarfs of which shall not be less than 4 feet long. The girders or floor beams of white pine, 9×15 inches, placed as represented in figure 3, one in every three of which shall pass through the whole width of the bridge, without scarfing; the ends of the girders to be secured to the posts by spikes, ⅜-inch square, and 15 inches long. The joists of white pine, 5×7 inches, placed at distances of two feet from centre to centre. The floor plank for side-ways of white pine, 3 inches thick, 19½ feet long, clear of sap and other defects, about one foot wide; the floor plank for the middle way 5 feet long, 3 inches thick. The tie-beams, connecting the plates in upper part of bridge, 6×12 inches, to project one foot over the plates. The side braces of white oak, 4½×5 inches, to be secured by mortices, tenons, and spikes as the engineer may direct. The horizontal braces in floor and roof of white pine, 6×6 inches, secured at each end or joint by mortices, tenons, and keys. The rafters to be 3×5 inches, supported by a ridge plate in centre, and by purlins and raising plates, 6 inches square, as represented in Figs. 5, 7, and 8. The shingles of Carolina cedar, 30 inches long, to be dressed and laid on black oak lath, 9 inches to the weather; the outside studding for the reception of the weather boarding to be of white pine, 3×4 inches, placed 2 feet apart from centre to centre, in a perpendicular position. The weather boards to be of white pine, ⅞ inches thick, put on in regular courses, to be planed on both sides, the studs also to be planed. Over each end of each pier, the bridge to be finished as represented in fig. 2, with Venetian windows; sky-lights of 4 feet square to be placed over each side of the roof, in the centre of each span. All the timbers of the bridge above the floor, except the upper beams and rafters, to be planed smooth.

From an intermediate point between, and on a line with the footings of the arches, two braces shall extend to the intersection of the arches and chords, as represented in Figs. 5 and 6, at which point an iron bar, two inches square, shall pass through the whole width of the bridge; and at the footings of said braces upon the pier, together with those of the arches, cast-iron shoes shall be placed, as represented in the drawing. At the intersection of the arches and posts, together with those of the chords and posts, iron screw bolts, 1¼ inches square, are to pass through them, and to be secured by a nut, worm, and screws. The joints or scarfs of the chords to be at least four feet long, and secured as represented in the drawing. Each end of the bridge is to be finished with six Grecian Doric columns, entablature, and pediment, which, together with the outside of the bridge, shall be painted with three coats of white lead.

It is understood that all the above work, whether of wood, stone, or iron, shall be executed in a faithful and workmanlike manner, without omitting anything which may not have been expressed in the above specification, and that the bridge, when completed, shall be in conformity with the plans heretofore referred to.

[Here follows a description of the particulars in which there had been deviations from the specification. They relate almost exclusively to the piers, and state that the length of spans in clear between the footings of arches, commencing at west end of bridge, was as follows: Nos. 1 and 2, each 122 feet; Nos. 3, 4, and 5, each 135 feet; Nos. 6 and 7, each 136 feet.]

The foundation of all the piers was solid rock, except two, which rested on hard gravel. Their height varied from 46 feet to $59\frac{8}{10}$ feet.

Final Estimate, Schuylkill Bridge, Dodd, Bishop & Brittin, Contractors.

19,100¼ perches masonry, at $4.37½	$83,563 59
1,050 feet lineal of platform, at $30	31,500 00
260 cubic yards excavation, at 8 cents	20 80
1,002 cubic yards rock excavation, at 60 cents	601 20
2,475 cubic yards embankment, at 12½ cents	309 37½
Coffer dam at east abutment, extra	3,619 50
Coffer dam at Pier No. 2, injured by ice	1,000 00
Coffer dam at Piers 4, 5, and 6, extra size	3,500 00
1,700 perches rip raps, at $1.25	2,125 00
Covering piers in winter	250 00
Fencing	62 00
Extra dowels and clamps	287 38
Extra cement in piers	84 00
Extra coping on pier heads	108 00
Extra coping on piers	441 00
Laying double track of rails	1,302 00
Inside painting	1,394 65
Timber furnished for other work	240 48
Pumps furnished for other work	16 00
Extra timber, iron, and workmanship	3,521 60
	$133,946 57½

It will be seen that, in contrast with modern prices for similar work, the bridge was a marvel of cheap construction. The masonry, costing $4.37½ per perch, could scarcely now be replaced for less than $15, and the platform, costing $30 per 1,000 lineal feet, would now probably cost twice that sum. During a series of years the Philadelphia and Reading made numerous repairs, decaying or weakening portions of the structure being replaced, but no material change was made in any of the important features of the bridge.

TOWN LATTICE BRIDGES.

While work on the Philadelphia and Columbia Railroad was progressing, the Town lattice plan was attracting an increased degree of attention, and it was adopted as the superstructure of the viaduct over the Big Conestoga creek. Its leading merit was relatively small cost, as thick plank were substituted for heavy timbers. Under ordinary conditions, it was generally found to possess sufficient strength, and it was used, during a comparatively brief period, in the progress of railway construction in Pennsylvania and other states. Its power to resist some forms of wind pressure, however, was not fully sufficient, and it was succeeded by more satisfactory methods.

PROTECTION OF WOODEN BRIDGES.

Great importance was formerly attached to the covering of expensive wooden bridges with a substantial roof which served as a protection. The passage of locomotives created serious danger of the destruction of these roofed wooden bridges by fire, and several safeguards were adopted. One was to employ a watchman, charged with the duty of passing over a bridge immediately after each train movement, and he carried a bucket of water in his hand for the purpose of extinguishing any incipient conflagration. Large tubs or half-hogsheads, filled with water, were placed at convenient points on each bridge to serve as reservoirs. Another, which was enforced on the Schuylkill bridge for a considerable period, was to interdict locomotives, all cars being drawn over the bridge by horses or mules to and from the western bank, where the connection with the inclined plane was made.

DRAW BRIDGES.

A description of the Raritan viaduct on the New Jersey Railroad, says that it was on Col. Long's plan, 1,700 feet in length, in spans from 112 to 145 feet reach. Depth of truss, 22 feet; width between hand rails on top, 31 feet; piers, 7 in number, which, with the two abutments, are faced with sienitic granite. The structure is of two stories; the lower floor resting upon the bottom of the trusses, of which there are three, supports a roadway to accommodate common carriages. The railway reposes on the top of the trusses, supported by joist bearers 4 feet apart. The chairs, holding the rails, rest on strong pieces, 4 inches thick by 11 wide, pinned down to the upper floor, which latter performs the office of a roof. The braces of the truss framing abut upon pieces of thin sheet iron, introduced into the points. At a depth of 9 feet from the tops of the piers and abutments, there is an offset of 9 inches, upon which are footed the shore braces that assist in supporting the trusses.

There are four distinct sliding draws, two in each story. The railroad draws move back into the place of a section which slides sideways, out of the way, while the common road draws roll on, opening over the part of the bridge back of them; a movable platform connecting the draws with the floor of the bridge, being raised up from it by means of lever beams, when the draw is about to be opened for the passage of vessels. The spans of the draws are each 30 feet, and those in the railroad cost $3,000 to $4,000 each.

INCLINED PLANES.

ONE of the subjects which attracted much attention at the outset was inclined planes, and the extent to which they should be avoided or adopted. As the primitive locomotives possessed very limited power as hill-climbers, and were mere pigmies in contrast with their successors in size and capacity, it seemed at one time to be absolutely necessary that railways intended to traverse mountainous countries over routes which necessitated heavy grades should be supplemented by inclined planes, on which stationary engines would furnish the motive power. It was in accordance with this idea that some of the earliest coal railways, and especially the Delaware and Hudson, were supplied with inclined planes, and that such adjuncts were originally provided at both ends of the Philadelphia and Columbia Railroad, and on the Portage Railroad. It should be remembered that each of the important improvements in locomotives that helped to increase their power to ascend steep grades diminished the necessity for inclined planes.

As the Portage Railroad was used to cross the summits of the Allegheny mountains, it was the most important undertaking of the kind in this country, and in the world, at the period of its construction. Of this road Mr. Solomon W. Roberts says: "There were eleven levels, so called, or rather grade lines, and ten inclined planes, on the Portage, the whole length of the road being 36.39 miles. The planes were numbered eastwardly from Johnstown, and the ascent from that place to the summit was 1,171.58 feet in 26.59 miles, and the descent from the summit to Hollidaysburg was 1,398.71 feet in 10.10 miles."

The planes were all straight, and their lengths and elevations, together with the length of the grade lines or levels, which were worked first by horse power, and subsequently by locomotives, are stated in the following table:—

	Length.	Rise. Feet.
Level No. 1, from Johnstown to Plane No. 1..	4.13 miles.	101.46
Plane No. 1, ascending eastward	1,607.74 feet.	150.00
Level No. 2, ascending eastward to Long Level.	13.06 miles.	189.58
Plane No. 2, ascending eastward	1,760.43 feet.	145.40
Level No. 3, ascending eastward	1.40 miles.	14.50
Plane No. 3, ascending eastward	1,480.25 feet.	130 50
Level No. 4, ascending eastward	1.90 miles.	18.80
Plane No. 4, ascending eastward	2,198.94 feet.	187.86
Level No. 5, ascending eastward	2 56 miles.	25.80
Plane No. 5, ascending eastward	2,628.60 feet.	201.64
Level No. 6, ascending eastward to Summit Level at Blair's Gap	1.62 miles.	19.04
		1,171.58
		Fall. Feet.
Plane No. 6, descending eastward	2,713.85 feet.	266.50
Level No. 7, descending eastward	.15 miles.	0.00
Plane No. 7, descending eastward	2,655.01 feet.	250.50
Level No. 8, descending eastward	.66 miles.	5.80
Plane No. 8, descending eastward	3,116.92 feet.	307.60
Level No. 9, descending eastward	1.25 miles.	12.00
Plane No. 9, descending eastward	2,720.80 feet.	189.50
Level No. 10, descending eastward	1.76 miles.	29.59
Plane No. 10, descending eastward	2,285.61 feet.	180.52
Level No. 11, descending eastward to Hollidaysburg	3.72 miles.	146.71
		1,398.71

STATIONARY ENGINES *vs.* LOCOMOTIVES.

In regard to the economic considerations involved in the use of inclined planes and stationary engines, Jonathan Knight, said in 1832: "So recently as the beginning of the year 1829, the relative economy of the stationary and locomotive systems, upon level railways, or upon those but slightly inclined, was warmly contested in England, and the question was not put to rest until the recent improvements in the locomotive engine took place." He added that on the Liverpool and Manchester Railway, after the improved engines (of Stephenson) were used, it was found that "the expense per ton per mile, by these engines, will be .164 of a penny, and by the stationary system .269 of a penny." Knight estimated in 1832 that in this country it was probable "that an engine, capable of conveying 30 tons of freight 120 miles in a day, will cost, including interest, repairs, renewals, engineering attendance, and fuel, from $9 to $15 per day, according to the price of fuel at the place demanded; and the cost per ton per mile, in the one case, will be ¼ of a cent, and in the other something less than ½ of a cent—more exactly .417 of a cent." In brief, as locomotives were improved the utility of inclined planes diminished.

The necessity of overcoming heavy grades by some methods is so imperative in all the mountainous portions of this country that the field of railway usefulness, and the limitations to the speed and cheapness of railway movements, would have been greatly restricted if the power of locomotives to draw relatively heavy loads over steep grades had not been greatly increased by American expedients and invention.

The nature of the delays and increase of expenditures caused by the enforced use of inclined planes may be inferred from the statement of Mr. Solomon W. Roberts that, on the Portage Railroad, "at the head of each plane were two engines, of about thirty-five-horse power each; and each engine had two horizontal cylinders, the pistons of which were connected with cranks at right angles to each other, which gave motion to the large grooved wheels, around which the endless rope passed, and by which the rope was put in motion. The engines were built in Pittsburgh, and could be started and stopped very quickly. One engine only was used at a time, but two were provided, for the greater security. Hemp ropes were at first used, and gave much trouble, as they varied greatly in length with changes in the weather, although sliding carriages were prepared to keep them stretched without too much strain; but wire ropes were afterwards substituted, and were a great improvement."

In the absence of inclined planes, horse power was sometimes used on the heavy grades of early roads, even after locomotives drew trains on level portions of such lines.

In the famous work of Charles Dickens, entitled American Notes, he gives the following description of his

JOURNEY OVER THE PLANES OF THE ALLEGHENY PORTAGE RAILROAD.

"We left Harrisburg on Friday. On Sunday morning we arrived at the foot of the mountain. which is crossed by railroad. There are ten inclined planes, five ascending and five descending; the carriages are dragged up the former, and let slowly down the latter, by means of stationary engines; the comparatively level spaces between being traversed, sometimes by horse, and sometimes by engine power, as the case demands. Occasionally the rails are laid upon the extreme verge of a giddy precipice; and looking from the carriage window, the traveler gazes sheer down, without a stone or scrap of fence between, into the mountain depths below. The journey is very carefully made, however, only two carriages traveling together; and while proper precautions are taken, is not to be dreaded for its dangers."

PORTAGE RAILROADS AND THEIR USES.

The application of a number of the early railways to purposes similar to those served by portages in the Indian and primitive American systems of transportation, was probably better illustrated by the Portage Railroad than any other line, and this fact presumably suggested its name. Soon after its construction it was applied to the novel purposes described in the following statement: "In October, 1834, Jesse Chrisman, from the Lackawanna, a tributary of the North branch of the Susquehanna, loaded his boat, named '*Hit or Miss*,' with his wife, children, beds, furniture, pigeons, and other live stock, and started for Illinois. At Hollidaysburg (on the east side of a high ridge of the Allegheny), where he expected to sell his boat, it was suggested by John Dougherty, of the Reliance Transportation Line, that the whole concern could be safely hoisted over the mountain and set afloat again in the canal. Mr. Dougherty prepared a railroad car to bear the novel burden. The boat was taken from its proper element and placed on wheels, and under the superintendence of Major C. Williams the boat and cargo at noon on the same day began the progress over the rugged Allegheny. All this was done without disturbing the family arrangements. They rested a night on the top of the mountain, descended the next morning into the valley of the Mississippi, and sailed for St. Louis. After this incident boats were so constructed that they could be divided into sections and hauled over the railroad on trucks without breaking bulk, but they were not extensively used until about 1840. Cars were also used which could be lifted from their trucks and loaded on boats of special construction."

METHOD OF OPERATION.

At a meeting, held in 1885, of Juniata boatmen, at Hollidaysburg, Captain D. H. Boulton read a paper describing the travel on the Portage Railroad, which contained the following statement:—

"The cars were loaded at Hollidaysburg, freight lifted from the gunwale to the cars by main strength. As many of you remember, if we worked hard all night, and started off in the morning, we had the pleasant assurance that, if we were so fortunate as to get over our thirty-six miles of road that day, we would have the privilege of loading in the Johnstown freight house the next night, sometimes working seventy-two hours consecutively in busy seasons. This we called 'a bad run.' When loaded, they were hauled by teams to Gaysport. The official in charge was not then called conductor, but captain. We were all captains. He having received from the collector's office his passport or right of way (the cars were weighed by H. A. Boggs, or some other weigh master of the honest old commonwealth), we were ready to start. A boat loaded from ten to twelve cars. This made two trains of five or six cars each, and was taken in charge by two men. The front car was the lever car. The brakes were wooden blocks drawn down on top of the wheels by means of a long pole at the side of the car. It was a rare thing to have more than one lever car to a train. We now attach to an engine, and are hauled to the foot of Plane No. 10 up a fifty-foot grade by Barney McConnell or Eli Yoder. Here Galbraith, McCormick, or Gardner, with their strong teams, would drag us, two or three cars at a time, to the hitching ground. 'Your clearance, captain,' would cry the familiar voice of Thomas Holiday or James McKee. After satisfying them that this was the train entitled to pass, they would attach our cars to a hempen rope by means of a hempen stop. (In after days wire rope and iron chains took the place of these). Two cars being drawn up, the process was repeated until the entire train had arrived at the top of the planes."

FIRST ASCENT OF AN INCLINED PLANE BY A LOCOMOTIVE.

In the reminiscences of Mr. W. Milnor Roberts, one of the distinguished early American railway engineers, which he read at a meeting of the American Society of Civil Engineers, in May, 1878, he said:—

"In 1836, my friend William Norris, invited me to meet a number of gentlemen to witness a promised performance of one of his locomotives, namely, to take a passenger car (eight-wheeled), with fifty persons in it, up the Schuylkill inclined plane, at the rate of ten miles an hour. The first morning this experiment was to be tried it was found that some malicious or humorous individual had greased the track, which prevented the test for that time, but shortly after, when the grease had been removed, his locomotive actually performed as he had promised. A careful record of the performance was printed in a quarto pamphlet at the time, but I have not seen it for a great many years. One of the passengers was an English officer, who (as Mr. Norris afterward told me), when he related the occurrence in England, was not credited, the railroad *savants* on the other side having already 'decided' that the limit of locomotive possibilities stopped very far short of 422 feet per mile rise, which was the grade of the Schuylkill plane. The length of this plane was about half a mile."

Other notable performances in hill-climbing of American locomotives, constructed by various builders, occurred at later dates, and after the fact became well established that locomotives could ascend grades as heavy or even heavier than those on which inclined planes had been constructed, few or none of these devices were applied to new roads intended for miscellaneous traffic, and those in existence were supplemented by tracks available for locomotives as speedily as possible. This remark, however, does not apply to some of the coal or other mining roads.

RAILWAYS AS PUBLIC HIGHWAYS.

HORSE POWER *vs.* LOCOMOTIVES.

THE roadway being constructed, the next important consideration related to the nature of the vehicles and motive power to be used. In some cases very intricate questions arose in connection with this subject. They gained complexity from the fact that there were no precedents for a transportation system adapted to miscellaneous traffic that combined with control and ownership of the road control and ownership of vehicles, and the power by which they were propelled. In this respect, the modern railway, in its relations with the public, has established an innovation of enormous industrial and financial significance. The gradual approaches towards the ascendency of this system form one of the most important features of railway development. At the outset nearly every imaginable divergence in practice was represented by the operations of some one or more of the numerous lines. In some cases, where the use of horse power had originally been contemplated, and had actually commenced, there were serious struggles against the substitution of locomotives, which, it was soon seen, would be incompatible with a continuance of horse power; and on the railways constructed by the state of Pennsylvania, after it had solved the first difficulty by excluding horses, and providing locomotives to furnish motive power, all the vehicles or cars used in moving freight or passengers continued to be owned by individuals, firms, or private corporations until the commonwealth disposed of her public works, after her railways had been in operation under state management for nearly a quarter of a century.

The earnest champions of railway improvements intended for general use speedily became satisfied that the locomotive was an indispensable adjunct. The prevailing feeling in such circles is well expressed by an early advocate of railways, who said: "The public in general entertain wrong impressions respecting railways. They never hear them mentioned without recurring to such as are seen in the neighborhood of coal pits and stone quarries. But such improvements have taken place that they are no longer the same thing; besides which, a railway without a locomotive engine is something like a cart without a horse, a trade without profit, or a canal without water."

PUBLIC HIGHWAY THEORIES.

Of the operations on the Portage road, before locomotives were used, Mr. Solomon W. Roberts says: "The experiment of working the road as a public highway was very unsatisfactory. Individuals and firms employed their own drivers, with their own horses and cars. The cars were small, had four wheels, and each car would carry about seven thousand pounds of freight. Usually four cars made a train, and that number could be taken up and as many let down an inclined plane at one time, and from six to ten such trips could be made in an hour. The drivers were a rough set of fellows, and sometimes very stubborn and unmanageable. It was not practicable to make them work by a time-table, and the officers of the railroad had no power to discharge them. My memory recalls the case of one fellow who would not go backward, and could not go forward, and so obstructed the road for a considerable time.

It resembled the case of two wild wagoners of the Alleghenies, meeting in a narrow mountain pass, and both refusing to give way. Our nominal remedy was to have the man arrested, and taken before a magistrate, perhaps many miles off, to have him fined, according to the law, a copy of which I used to carry in my pocket.

When the road had but a single track between the turnouts, a large post, called a centre post, was set up half-way between two turnouts, and the rule was made that when two drivers met on the single track, with their cars, the one that had gone beyond the centre post had the right to go on, and the other that had not reached it must go back to the turnout which he had left. The road was, in many places, very crooked, and a man could not see far ahead. The way the rule worked was this: When a man left a turnout he would drive very slowly, fearing that he might have to turn back, and, as he approached the centre post, he would drive faster and faster, to try to get beyond it, and thus to drive back any cars that he might meet, and in this way cars have been driven together, and a man killed by being crushed between them. We had no electric telegraphs in those days."

He also states that when a bill was pending in the state legislature to authorize the purchase of locomotives, he was journeying in a horse car towards Harrisburg, on the Philadelphia and Columbia Railroad, and says: "Two gentlemen were sitting opposite to me who were members of the legislature from Chester county, one being a senator. The car stopped, and a man spoke to my traveling companions, saying that he hoped they would oppose the bill to authorize the canal commissioners to put locomotives on the road and control the motive power. The senator said that it should never be done with his consent. Thereupon, as the car drove on, I proceeded to argue the matter, but with poor success; the reply being, that the people were taxed to make the railroad, and that the farmers along the line should have the right to drive their own horses and cars on the railroad, as they did their wagons on the Lancaster turnpike, to go to market in Philadelphia; and that, if they were not permitted to do it, the railroad would be a nuisance to the people of Lancaster and Chester counties. It required time to overcome this feeling."

SUPPOSED ANALOGY BETWEEN RAILWAYS AND TURNPIKES.

Similar difficulties sprang up in other quarters. A distinguished lawyer, George Ticknor Curtis, referring to this subject in 1880, said:—

"I remember—for I am old enough to have witnessed the origin and growth of the whole railroad system of this country, being already a student-at-law before any railroad had been put into operation in America—that the ideas of the first projectors of the railroads in New England, and of the public, as to the use that would be made of them, were exceedingly crude. The earliest charters granted in Massachusetts contain traces of an expectation that the company would lay down the rails, and that the public would somehow drive their own carriages over them. In this imperfect conception of what was to be done, the railroad, it was supposed, would be operated like a chartered turnpike, the proprietors having the right to take tolls of those who should drive their own carriages over the road. It was not until a later period, after the English example was better known, that it was seen here, that a railroad could not be worked like a chartered turnpike, or like a public highway; that it would be impracticable to admit the carriages of individuals to pass over the rails; that the company which built the road must operate it; and that individuals of the public must stand in the same relation to this new species of common carrier, that they occupy in regard to all common carriers, and must make contracts for the transportation of their persons or property, by a carrier who would own the vehicle and the propelling power, as well as the road over which the vehicle was to pass. The supposed analogy, therefore, between the railroad and the chartered turnpike, over which any one could drive his own vehicle on payment of the authorized toll, or between the railroad and the public highway, built and maintained at the public expense—an analogy which misled some of the earliest projectors of railroads—entirely disappeared."

NECESSITY OF EFFECTIVE REGULATIONS.

Theoretically, the railways of some states are still legally declared to be public highways, and on many lines numerous cars belonging to individuals, freight organizations, or other railway companies are constantly passing. But the right to impose appropriate restrictions relating to the condition of these foreign cars is never seriously questioned, and its exercise is absolutely necessary to ensure safety.

Railroading is the practical application of the best attainable mechanical and engineering devices to the science of land transportation. Unlike all previous systems for promoting that great end, it combines approximately equal attention to the road to be traveled, or the permanent way, on the one hand, and the vehicles to be used and the motive power by which they are to be propelled, on the other. The physical welfare of mankind hinges on the degree of success with which transportation problems are solved to a greater extent than on the result of mechanical labors of any other kind, because cheap and rapid movement of persons and property is the most vital element of all forms of progress. Railroads represent the first effort to construct and maintain thoroughly effective avenues for great inland movements, inasmuch as their successful operation requires that prompt and thorough repair and maintenance of the line traversed which never was, and probably never will be, secured on highways owned and managed by one set of persons or authorities and used mainly by vehicles belonging to a large body of miscellaneous owners.

At the same time, under appropriate restrictions, it has been found mutually advantageous for each of many lines to grant a right of way and to furnish motive power to cars of other lines, and there have been times and contingencies in which the idea of confining the use of a railway exclusively to cars of the company owning it has been enforced to an injurious extent.

A report on internal commerce of the United States for 1876 says:—

"Many of the abuses and evils which have sprung up with the railroad system are traceable to the fact that railroads have never been, and, perhaps, in the nature of things never can become, free highways in the sense in which the term 'free' applies to navigable waters and to wagon roads. When railroads were first introduced, it was supposed that they could be operated in the same manner as other public highways; but it was soon demonstrated that upon an avenue of commerce the pathway of which is no wider than the wheel of the vehicle which moves upon it, not only the road itself but the entire equipment and motive power must be placed under the control of one central organization. The peculiarities of the railroad as a public highway are based upon this mechanical feature, and to it may be directly traced almost every question which has arisen respecting the relations of the railroad to the public. The circumstance just alluded to gave to the railroad system certain marked characteristics of monopoly, and at an early day serious apprehensions were entertained as to the abuses which might arise in the course of the development of the system. But the popular demand for railroads at almost any cost set at rest all these fears. Some of the evils encountered have in the progress of events worked out their own cure, some have been adjusted by legislation and by the courts, some have been corrected by the railroad companies themselves, while others remain unsettled, constituting what is termed 'the railroad problem of the day.'"

EARLY LOCOMOTIVES.

RAILWAY construction never fails to excite intense interest in the communities in which the startling process of making an approximately level road by deep cuts, high embankments, expensive tunnels, and the erection of lengthy viaducts or bridges, is witnessed for the first time, and after the line has become a fixture the next object to excite curiosity and attract earnest attention is the locomotive.

PIONEER AMERICAN LOCOMOTIVES.

Current histories of locomotive development in the United States usually speak of imported English locomotives as the basis of all practical operations in this country. In one sense, this view may be correct, but it scarcely does justice to the ideas developed and labors performed here. The great sensation made by the successful effort of Oliver Evans, in the early part of the century, to endow a steam engine with power to move itself over the streets of Philadelphia, typified the germs of much that was first accomplished in England, not on account of priority of invention, but because requisite financial aid was lacking here, and attainable there. Mr. Horatio Allen, who ordered and ran the first locomotive ever used on an established American railway, in an interesting sketch, written in 1884, of the first five years of the railroad era, says: "As early as 1780, and before Watt had perfected and introduced the condensing engine, Oliver Evans had matured his plan of a high-pressure engine, and had applied it to do work as a stationary engine. It is of interest to know that the boiler which Oliver Evans constructed and used was a *multitubular* boiler, but differing from the multitubular boiler now the established boiler of the locomotive in the particular that in the Evans boiler the water was in the tubes, and the products of combustion passed between the tubes, whereas in the present locomotive boiler the products of combustion pass through the tubes, and water surrounds them. What was accomplished by Oliver Evans had all the elements of a permanent success. Had Evans had a Boulton, as Watt had a co-operating Boulton, or a Pease, as George Stephenson had his Pease, as a co-operator, the high-pressure steam-engine would have had a position from that time of great interest to the country, and, through this country, to the world; but no such aid coming from individual or state, vainly applied to, there is only the record of what might have been—another of the many cases where the inventor was ready, but the age was not."

Another locomotive was made by an American citizen before any English locomotives were imported. In George W. Smith's notes to Wood's Treatise on Railroads, published in 1832, referring to the tubes used on the Rocket engine, made for the Liverpool and Manchester Railway, he says: "Boilers, containing flues or tubes, filled with water or heated air, have repeatedly been used for steam engines, and frequently proposed for locomotive engines. Their lightness and efficiency obviously adapted them to this purpose. In 1825 Mr. John Stevens, of Hoboken, New Jersey, constructed and used a locomotive engine, the boiler of which was entirely composed of tubes of an extremely small diameter, filled with water."

Soon after railway construction had advanced to the stage that created a demand for locomotives, several Americans designed and partially or wholly constructed them in accordance with plans that differed in important respects from contemporaneous English machines. The pioneers of this class include Peter Cooper, Long and Norris, and Phineas Davis.

IMPORTED ENGLISH LOCOMOTIVES.

There had, however, been in England, during a score of years, efforts to construct locomotives, intermingled to a moderate extent with their practical use, and a succession of improvements, which had been tested in working operations, chiefly on colliery railways, before any American railway companies had finished lines with the intention of using steam power, and it was natural that the first machines intended for actual service should be imported. Of the three English engines purchased by the Delaware and Hudson Canal Company in 1828–29, two were similar to the famous Rocket. They were first put in working order at the West Point Foundry, in New York, at which establishment the first American engine ordered for actual service was constructed, but the English locomotives bear little outward resemblance to that engine, which was the "Best Friend," used on the South Carolina Railroad.

At that day, as at all subsequent periods, the locomotive was pre-eminently a progressive machine, improvements being frequently made, and it is supposed that a number of the early English locomotives sent over to this country, soon after the arrival of those forwarded to the Delaware and Hudson, were of the Planet type. It represented important improvements on the Rocket, which won the prize offered by the Liverpool and Manchester. As the Planet type may perhaps be regarded as the model of practical American locomotive construction, to a greater extent than any other type, the following contemporaneous description of its first public performances, which originally appeared in a Liverpool paper, is republished here:—

"On Saturday last (4th December, 1830), the Planet engine, Mr. Stephenson's, took the first load of merchandise which has passed along the railway from Liverpool to Manchester. The team consisted of 18 carriages, containing 135 bags and bales of American cotton, 200 barrels of flour, 63 sacks of oatmeal, and 34 sacks of malt, weighing altogether 51 tons, 11 cwt., 1 quarter. To this must be added the weight of the wagons and oil-cloths, viz., 23 tons, 8 cwt., 3 quarters. Tender, water, and fuel, 4 tons, and 15 persons on the team, 1 ton, making a total of exactly *eighty tons*, exclusive of the weight of the engine, about 6 tons. The journey was performed in 2 hours and 54 minutes, excluding three stoppages of 5 minutes each (only one being necessary under ordinary circumstances), for oiling, watering, and taking in fuel; under the disadvantages also of adverse wind, and of a great additional friction on the wheels and axles, owing to their being entirely new. The team was assisted up the Ramhill inclined plane by other engines, at the rate of 9 miles an hour, and descended the Sutton incline at the rate of 16½ miles an hour. The average rate on the other parts of the road was 12½ miles an hour, the greatest speed on the level being 15½ miles an hour, which was maintained for a mile or two, at different periods of the journey."

Mr. George W. Smith's appendix to Wood's Treatise on Railroads, published in 1832, in referring to engines which were probably of the Planet description, and also early American locomotives made at the West Point foundry, says:—

"A locomotive of the latest pattern (made by Robert Stephenson, of Newcastle-upon-Tyne, England), has been imported by the New Castle and Frenchtown. The spokes of the wheels are wrought-iron tubes, bell-shaped at their extremities; the rim and hub cast on them—the union being effected by means of boring. The wheels are encircled by a wrought-iron tire and flange—the latter is very diminutive, and will require enlargement. The weight of the engine is not adapted to a railway of slender proportions, composed of timber and light rails.

A locomotive, weighing 12,742 pounds, made by R. Stephenson, at Newcastle-upon-Tyne, England, was tried on this road by the company. The wheels are of wood, the tires wrought iron. The weight injured the railway. Another locomotive, also owned by the company, made at West Point, weight 6,758½ pounds, wheels 4 feet 8 inches in diameter, is in use; the average speed, with a load of 8 tons, is 15 miles per hour, although 30 miles per hour have been accomplished with this load on the railway.

Three locomotives are now in operation on the South Carolina Railroad; one of them is supported on eight wheels—it was made at West Point."

The very early eight-wheeled locomotive here referred to was presumably constructed in compliance with a suggestion of Horatio Allen, chief engineer of the South Carolina Railroad, to the effect that by distributing the weight of the locomotive on eight wheels the pressure upon the light wooden railway would be diminished.

DEFECTS OF ENGLISH LOCOMOTIVES.

The best of the English engines of that day were not intended for use on the fragile wooden rails, the heavy grades, and sharp curves of American lines, and as they were made to burn coke, and not wood, and were not provided with the spark arresters necessary for wood-burning locomotives, they failed to serve the intended purpose to the desired extent. Modifications were evidently needed to compensate for the difference between the fragile, cheap, and crooked heavy-grade American lines, and the expensive and relatively solid, straight, and level English lines, and for the difference between wood- and coke-burning locomotives. One of the first of the improvements, which has since been almost universally used on American locomotives, was the introduction of the locomotive truck, or bogie, of four wheels, underneath the front of the engine, which was suggested by Mr. John B. Jervis, one of the most distinguished of the early American civil engineers, when the first American locomotives intended for actual service were being constructed at the West Point Foundry. Its particular object was to support and govern the machine in running over curves. It is claimed that a similar device was embraced in a design of a locomotive by Long and Norris in 1829. An excellent substitute was also applied by Mr. Isaac Dripps to the English locomotives imported by the Camden and Amboy. Many other improvements were introduced from time to time, and the work of changing details is always progressing, with varying results. But the increased aid attained in traversing uneven or poorly constructed roads, by the use of the forward trucks or bogies, the power to ascend heavy grades, and the construction of spark arresters, were among the most notable of early American achievements, and they were soon succeeded by numerous useful inventions, which had the general effect of increasing the strength, speed, and power of locomotives, as well as their weight. The alteration or construction of locomotives was attempted, in a crude fashion, at various places. In a few cases the foundation was laid for gigantic establishments, while in other instances the novel undertaking was abandoned. While these native industries were being developed a few additional locomotives were also imported from England. One of the earliest of these imported locomotives was probably brought here for use on the New Castle and Frenchtown Railroad, and one of the most famous is still in existence, and it is claimed that at the time it was manufactured it was the best engine that had been made. It is the John Bull, ordered by Mr. Robert L. Stevens, for the use of the Camden and Amboy, in the fall of 1830, and built by Robert Stephenson & Co., Newcastle-on-Tyne. It arrived at Bordentown, New Jersey, in August, 1831. A trial trip was made early in September, 1831, and an exhibition of its powers before members of the legislature of New Jersey in November of that year facilitated the passage of a bill granting to the company the privilege of using locomotive power. This locomotive was exhibited at the Centennial Exposition in 1876, and at the Railway Exposition in 1883, and it has since been permanently deposited in the National Museum at Washington. It was in active service for more than thirty years.

The following statements relating to this engine are attributed to Mr. J. Elfreth Watkins, who had charge of the railway curiosity department of the National Museum at the time they were made: "This engine when it arrived in the country was substantially as it now is—with inside cylinders, four driving-wheels, and multitubular boiler. The driving-wheels originally had cast-iron hubs, and locust spokes and felloes, and a tire about five inches wide and flanged, shrunk on like the tire of an ordinary cart-wheel. There was no head-light, no bell, and no pilot. The steam-pipes were inside the boiler, and the dome was right over the fire-box. In the dome was a lock-up safety-valve, which the engineer could not reach. There was no cab, and no tender came with the engine. To take its place, when the first experiments were made, a tender was made of an ordinary construction car, with a whisky barrel to hold the water, which was fed to the engine through hose made by a shoemaker out of leather, connected with the tank by waxed thread. When this engine arrived in this country it was the most perfect locomotive in the world. It had been built by George Stephenson's firm as an improvement on the Planet, which, built in 1830, was the first engine which had the combination of horizontal cylinders, multitubular boiler, and the blast pipe. The 'John Bull' was the first engine running in this country which possessed these three essential features of a locomotive, for lack of which earlier engines in both countries were comparative failures."

MR. DRIPPS APPLIES A PILOT TO THE JOHN BULL LOCOMOTIVE.

In preparing the John Bull and fourteen other engines of similar design, the machinery of which was ordered and made in England, for actual service, Mr. Isaac Dripps, who had from the outset and during a protracted period the direction of motive power on the Camden and Amboy, adopted a peculiar device to enable the rigid English locomotives to turn curves, which differed from that devised by Mr. Jervis, but was also very effective. It consisted in the placing of two small wheels under a projection of the locomotive which corresponds in location with the modern cow-catcher, and formed the pilot. As an aid to this device, in facilitating the turning of curves, one of the forward driving-wheels of the locomotive was so arranged as to move around the axle instead of turning with it. By these ingenious arrangements the curve-turning difficulty was completely overcome, not only on the John Bull but on fourteen other engines of a similar pattern, which remained in active service for about a score of years.

Another locomotive, called John Bull, was used on an early New York railroad. The Baltimore and Susquehanna (now the Northern Central) imported an English locomotive, called the Herald, at an early date. Orders for a few other English locomotives continued to be intermingled with contemporaneous orders for American machines during several years, and at the outset considerable inconvenience and disappointment resulted from the failure of the English works to adopt devices necessary to meet the difficult conditions existing on most of the early American lines, and from the lack of the requisite facilities for satisfactory work in pioneer American shops.

EARLY AMERICAN LOCOMOTIVES.

On the portion of the Baltimore and Ohio first constructed and on various other early lines, notably the Mohawk and Hudson, the Philadelphia and Germantown, the Camden and Amboy, and Philadelphia and Columbia, horse power was originally used to draw cars. The South Carolina Railroad is said to be the first railway in this or any other country which was constructed from the outset with the understanding that locomotives only were to be employed, but even on it vehicles drawn by horses were used to a limited extent before locomotives were procured. As the first section of the Baltimore and Ohio abounded with sharp curves the question arose whether, on such a line, locomotives could ever be successfully substituted for horses. The prevailing opinion in England at that time was that locomotives could neither ascend heavy grades nor turn very sharp curves. It was mainly to demonstrate that this view was erroneous, and that the curves on the Baltimore and Ohio were not too sharp to permit the use of such forms of a locomotive as could be constructed, that Peter Cooper made a locomotive which, although it was so diminutive that it was little more than a working model, fully accomplished its intended purpose. It is generally regarded as the first American locomotive, and probably was, if the previous efforts of Evans and Stevens, heretofore referred to, are not cousidered. A locomotive of a size adapted for continuous service was also made by Long & Norris, which was probably designed and may or may not have been completed before

THE TRIAL TRIP OF THE COOPER LOCOMOTIVE.

That trial trip was made on August 28th, 1830, and a contemporaneous account which, it is said, was written by Ross Winans, published in the Baltimore Gazette, of September 2d, 1830, says it "tested a most important principle, that curvatures of 400 feet radius offer no material impediment to the use of steam power on railroads when the wheels are constructed with a cone on the principles ascertained by Mr. Knight, chief engineer of the Baltimore and Ohio Railroad

Company, to be applicable to such curvatures. The engineers in England have been so decidedly of opinion that locomotive steam engines could not be used on curved rails, that it was much doubted whether the many curvatures on the Baltimore and Ohio Railroad would not exclude the use of steam power. We congratulate our fellow citizens on the conclusive proof which removes for ever all doubt on this subject, and establishes the fact that steam power may be used on our road with as much facility and effect as that of horses, and at a much reduced expense."

PIONEER LOCOMOTIVE WORKS.

Outlines of the history of the successful and enduring locomotive works have been published, and if the rule of the survival of the fittest can properly be applied to such subjects, it would be difficult to give too much credit to the men identified with the establishment and continuance of the Baldwin Locomotive Works, and Rogers' works at Paterson. But it is noticeable that there were a number of pioneers who have left no business successors to eulogize their labors and perpetuate their memories. Colonel W. Milnor Roberts states that when he was instructed by the directors of the Cumberland Valley road (of which 50.50 miles were in operation in 1836) to procure the construction of a number of locomotives, "there were comparatively few locomotive manufactories in the United States, and they were on a small scale," and that he "went to Alexandria, Virginia, where there was a locomotive establishment, and made a contract for locomotives to be delivered in a few months." He adds: "I then went to New Castle, and made a contract for another locomotive, and then took the boat for Philadelphia. There were two locomotive works in that city, Baldwin's and Mr. Norris'. Baldwin had so much work in proportion to his force that he could not engage to deliver any in the time named. I made a contract with Norris for two at first, and two more afterwards. I then proceeded to Boston and Lowell, and I thought the Lowell road better than any I had yet traveled on. Lowell, even then, was a great manufacturing town, although comparatively in its infancy. I admired the appearance of the town, manufactories, crowds of girls, and the fine machine shops. Major Whistler was very obliging in showing me through the works, which, for that early period in railroading, were on a large scale, and well worth seeing. He soon informed me that they were so overrun with orders that they could not attempt to make any engines for our company. I then returned to Philadelphia and Carlisle, and then to New Castle, where I tested the engine, and found it to work satisfactorily."

He also says that he witnessed the "first experiment of applying steam to a trumpet. This was between 1831 and 1833," and that it was his impression "that this preceded the introduction of the locomotive steam whistle."

The fact that Mr. Roberts found a locomotive establishment at New Castle, with which he made a contract, at that period, was due to the circumstance that locomotives forwarded from England for use on the New Castle and Frenchtown Railroad had first been landed at that point, and their machinery put together there, and this New Castle and Frenchtown Railroad was one of the first lines in the United States, if not the first, on which regular passenger movements in cars drawn by locomotives were commenced, as it was an important link in a favorite Atlantic coast through route between northern and southern sections of the country. It was chartered February 7th, 1829, and opened in 1832, and a portion of the road now forms part of the Philadelphia, Wilmington and Baltimore. The Boston and Lowell Railroad, which he refers to as one of the best of the early lines, was chartered June 8th, 1830, and opened June 26th, 1835. The main line extended from Boston to Lowell, and was 26.35 miles in length. One of the most important of the early locomotive works of New England was established by Hinckley & Drury in Boston.

THE LONG & NORRIS AND NORRIS LOCOMOTIVE WORKS.

In connection with early locomotive construction, the works started by Col. Stephen H. Long and William Norris in Philadelphia, deserve special mention. Septimus Norris, in a communication dated Philadelphia, May 23d, 1856, and published in Colburn's Railroad Advocate, of June 14th, 1856, after referring to movements in England, says: "Now we have seen what England was doing, let us see what was going on in the United States. Col. S. H. Long, of the United States Topographical Corps of Engineers, and William Norris, Esq., a gentleman of acknowledged scientific attainments, were at this very time experimenting in the building of locomotives; and as early as May, 1829, they designed a locomotive to burn anthracite coal. The engine was arranged with two driving-wheels, five feet in diameter, placed in front of the fire-box; the cylinders outside, the front part of the engine resting upon a four-wheel truck, *turning and resting* on a *centre bearing,* in connection, and made fast to a bolster running across the truck frame. The peculiarity of the boiler was in the arrangement of the tubes, there being two sets, and between which was a space of some twenty inches, forming a combustion chamber for the gases and smoke. There was also attached to the boiler a fan-blower, driven by the exhaust steam, which was operated upon by the engineman at pleasure. This was used to produce artificial draught. . . . Long & Norris built an engine called the Black Hawk, which performed with only partial success on the Boston and Providence Railroad, also upon the Philadelphia and Germantown road in 1830. William Norris was undoubtedly the original designer of the accepted and adopted American locomotive, and to him alone belongs the credit of having built the first, and most thoroughly successful locomotive in the United States. His plans were unlike anything then known. The cylinders were placed outside, as in the Rocket, using wrought-iron frames, with the expansion, also a four-wheel pivoting, centre-bearing truck, also four eccentrics. These were the distinguishing features of William Norris's locomotive. In December, 1830, Long & Norris patented chilled driving-wheel tires, with different modes of fastening the tire to the centre, also the introduction of a heater, for heating the feed water before entering the boiler. January 17th, 1833, they originated and patented the four eccentrics and four eccentric rods, for working the valves of locomotive engines. December 30th, 1833, they also originated and patented the double valve, using the auxiliary valve as a cut-off, to work the steam expansively. In 1835, William Norris (who was then alone, Col. Long having withdrawn all interest from the firm), commenced the construction of an engine after his own ideas, based upon mechanical principles and science, with fixed opinions, he having seen, examined, and experimented with all known plans and proportions of locomotives in England and this country, looking closely to the very life and main spring of the engine, the valve motion and its appendages. This engine, the crowning point of all his efforts, was produced, and proved itself most successful, having performed a duty far beyond his most sanguine expectations.

The *George Washington* ascended the inclined plane upon the Philadelphia and Columbia Railroad, which is a grade rising one in $14\frac{7}{10}$ feet, or 359 feet per mile, taking up a load of some 53 persons, seated in two passenger cars, repeatedly coming to a stand on the grade, and again moving off with the load. After reaching the summit the engine was turned round, and came down head foremost, stopping in its descent. Here was a triumph, and to this day no other locomotive has ever attempted such a feat. Notice was made of it in the public journals of England, copied from the Philadelphia papers, which was ridiculed by all, calling it a Munchausen story, yet the English engineers could not be convinced of the fact until William Norris, in 1839, sent a single locomotive to England to run upon the Birmingham and Gloucester Railway, which performed a greater duty upon the Lickey inclined plane than he guaranteed. This caused the confirmation of a further order for 16 additional ones, which were built by William Norris in Philadelphia, and shipped to England in 1839 and 1840. This was a great triumph for an American engineer. It led to extended orders, and for several years afterwards William Norris continued to send from his workshops in Philadelphia some 170 engines to France, Germany, Prussia, Austria, Belgium, Italy, and Saxony. The performance of the Norris engines on the Lickey incline was so successful that the fixed power was at once abandoned, and the working power of this part of the line was reduced, comparatively, to so small a sum that the shares of the company advanced £5 each."

The Norris works held a leading position for a number of years in the magnitude of their operations, the speed of their locomotives, and readiness to adopt important improvements.

BALDWIN LOCOMOTIVE WORKS.

Although the first American locomotive continuously used in actual service was probably built at the West Point Foundry for the South Carolina or Charleston and Hamburg Railroad, Mr. Baldwin a few years later received an order to construct one engine for that road, which, it is said, was his second locomotive intended for actual service, the first having been built for the Germantown or Philadelphia, Germantown and Norristown road in 1832. Of this first Baldwin locomotive, which was called Old Ironsides, it is stated that its weight was 5 tons; driving wheels, 54 inches in diameter; cylinders, $9\frac{1}{2}\times18$ inches, and that wood was used for spokes and rim of the wheels, as well as for the frame of the engine. It closely resembled the English locomotives, but the Baldwin works soon began to adopt important improvements, some of which were invented by Mr. Baldwin, and others purchased from other inventors. A sketch of the Baldwin works contains the following reference to the period between 1830 and 1840:—

"The founder of the establishment was Matthias W. Baldwin, who learned the jewelry trade in 1817. He had a small shop, but in 1825 went into partnership with David Mason, a machinist, in the manufacture of bookbinders' tools and cylinders for calico printing. In devising a steam engine which should occupy the least space in his shop, Mr. Baldwin, about 1830, hit upon an upright engine of so novel and ingenious a form that attention was immediately attracted to it, and Mr. Baldwin received orders for others of the same pattern. This original stationary engine is still in good condition, and is carefully preserved at the works. In 1829-30 the use of steam as a motive power on railroads had begun to engage the attention of American engineers. A few locomotives had been imported from England, and one had been constructed at the West Point Foundry, in New York city. To gratify the public interest in the new motor, Mr. Franklin Peale, then proprietor of the Philadelphia Museum, applied to Mr. Baldwin to construct a miniature locomotive for exhibition at his establishment. With the aid only of the imperfect published descriptions and sketches of the locomotives which had taken part in the Rainhile competition in England, Mr. Baldwin undertook the work, and on April 25th, 1831, the miniature locomotive was put in motion on a circular track, made of pine boards covered with hoop iron, in the rooms of the museum. Two small cars, contaiuing seats for four passengers, were attached to it, and the novel spectacle attracted crowds of admiring spectators.

In the same year, 1831, Mr. Baldwin received an order from the Philadelphia, Germantown and Norristown Railroad Company, whose line was operated by horse power, for a locomotive. He undertook the work, and, guided by an inspection of the parts of an English locomotive, and by his experience with the Peale model, finally completed an engine which was christened 'Old Ironsides,' and tried on the road November 23d, 1832. It was put at once into service, and did duty on the Germantown road and others for over twenty years. The Ironsides was a four-wheeled engine, modeled on the English practice of that day, and weighed something over five tons. The price of the engine was to have been $4,000, but some difficulty was found in procuring a settlement. The company claimed that the engine did not perform according to contract, and objection was also made to some defects in it. After these had been corrected as far as possible, however, Mr. Baldwin finally succeeded in effecting a compromise settlement, and received from the company $3,500 for the machine. The Ironsides subsequently attained a speed of thirty miles per hour, and so great were the wonder and curiosity attached to it that people eagerly bought the privilege of riding behind it.

It was some time before Mr. Baldwin secured an order for another, but the subject had become singularly fascinating to him, and he made the most careful examination of every improvement, and experimented for himself. By the time the order for the second locomotive was received, Mr. Baldwin had matured this device, and was prepared to embody it in practical form. The order came from Mr. E. L. Miller, in behalf of the Charleston and Hamburg Railroad Company, and the engine bore his name, and was completed February 18th, 1834. It was on six wheels, one pair being drivers, four and a half feet in diameter, with half-crank axle placed back of the fire-box, and the four front wheels combined in a swiveling truck. The driving wheels, it should be observed, were cast in solid bell metal. These wheels soon wore out, and the experiment was not repeated. This locomotive weighed seven tons and eight hundredweight. About the same time other orders were received, and five locomotives were completed in 1834. These early locomotives were the type of Mr. Baldwin's practice for some years. The subsequent history of the various improvements is identical with the history of locomotive engineering in this country.

Patents were taken out or held by Mr. Baldwin for the various improvements to his locomotives September 10th, 1834; June, 1834; April 3d, 1835; August 17th, 1835; December 31st, 1840; August 25th, 1842, and many at more recent dates. Fourteen engines were constructed in 1836, forty in 1837, twenty-three in 1838, twenty-six in 1839, and nine in 1840. During all these years the general design continued the same, but three sizes were furnished, as follows:—

First class.—Cylinders, $12\frac{1}{2}\times16$ in.; weight, loaded, 26,000 pounds.

Second class.—Cylinders, 12×16 in.; weight, loaded, 23,000 pounds.

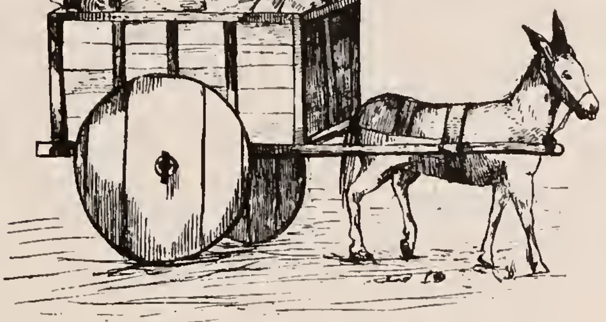
Third class.—Cylinders, $10\frac{1}{2}\times16$ in.; weight, loaded, 20,000 pounds.

The financial troubles of 1836 and 1837 had their effect on the demand for locomotives, as will be seen in the decrease in the number built in 1838, '39, and '40. In May, 1837, the number of hands employed was three hundred, but this was reduced weekly. April 9th, 1839, Mr. Baldwin associated himself with Messrs. Vail and Hufty, and the business was conducted under the firm name of Baldwin, Vail & Hufty until 1841, when Mr. Hufty withdrew, and Baldwin & Vail continued the construction of more powerful locomotives, and Mr. Baldwin, after careful consideration of the subject, took steps to supply a 'geared engine,' and the success of the first locomotive constructed under his new patent of 1840 was unprecedented. Only one of these was, however, built. The problem of utilizing more or all of the weight of the engine for adhesion remained, in Mr. Baldwin's views, unsolved."

EARLY LOCOMOTIVES ON COLUMBIA AND PHILADELPHIA RAILROAD.

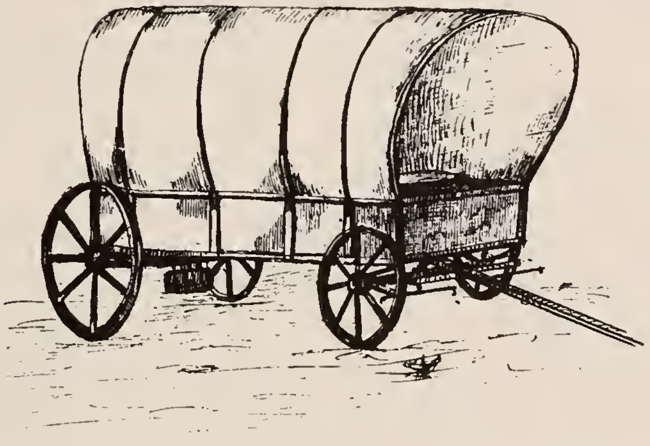
One track of the Columbia and Philadelphia Railroad was formally opened throughout its entire length, so as to be available for the use of locomotive power, in April, 1834. The locomotive used was the Black Hawk. The distinguished official passengers, including the canal commissioners and a number of members of the legislature, were conveyed from Columbia to Lancaster in fifty-five minutes, and on the following morning at eight o'clock the journey from Lancaster was commenced. A contemporaneous account states that the "train arrived at the Gap at ten, passed with ease the works there constructed, and arrived at the head of the inclined plane near the Schuylkill at half-past four in the afternoon, having made the trip in eight hours and a half, all stoppages for taking in water, receiving and discharging passengers, and incidental delays included. If it be borne in mind that the engine is one of very limited power, that the number of passengers was large, the weight of cars and baggage very considerable, and that the passage was made under the disadvantages inseparable from first attempts, all will concur in awarding to the engineer, and those in charge of the locomotive and train of cars, great praise for their skill in effecting so successful and gratifying an issue of the undertaking."

Of the first locomotive Mr. Baldwin built for the commonwealth of Pennsylvania, which was called the Lancaster, and completed in June, 1834, and which weighed 17,000 pounds, it was reported that it hauled at one time nineteen loaded burden cars over the highest grades between Philadelphia and Columbia. This was characterized by the officers of the road as an "unprecedented performance," and it probably was, but in estimating the magnitude of the service performed the fact should be remembered that the burden cars of that era were very diminutive affairs, in contrast with their successors.

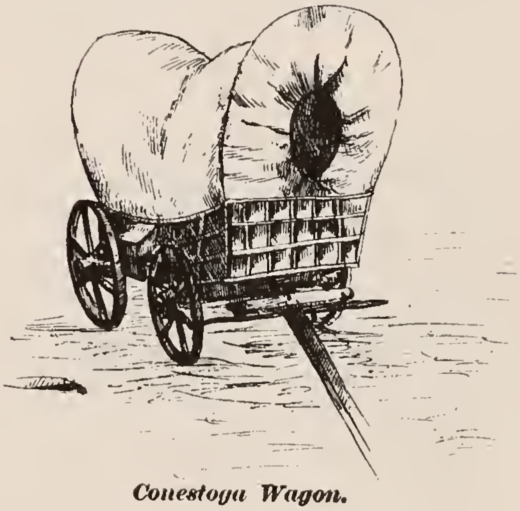


Cart with Wooden Wheels.

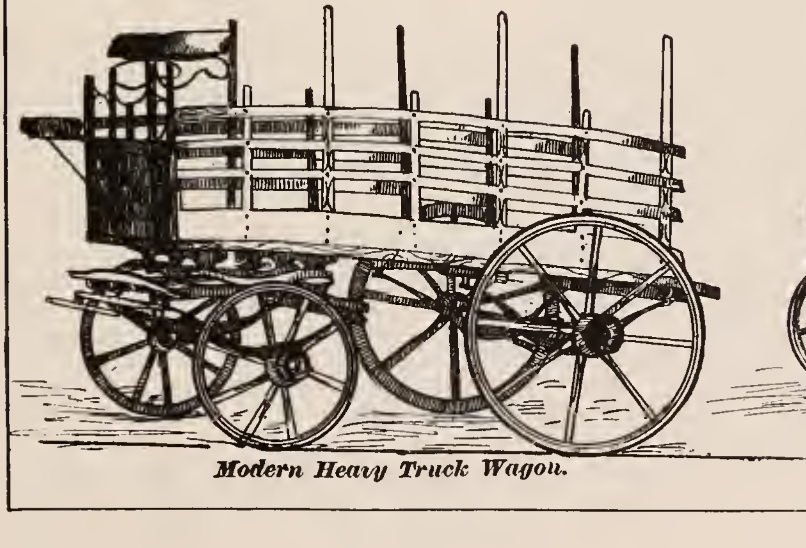
Mexican Cart.



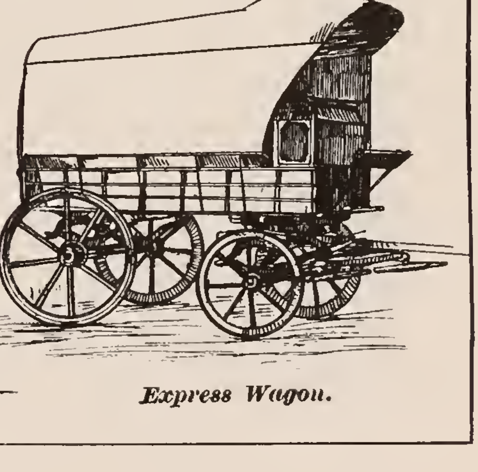
Jersey Wagon of 1800.



Conestoga Wagon.



Modern Heavy Truck Wagon.



Express Wagon.

The locomotives used on the Columbia and Philadelphia Railroad from 1839 up to a period some ten years or more later were obtained from various manufacturers, viz., M. W. Baldwin, Richard Norris & Sons, and Eastwick & Harrison, of Philadelphia; Dotterer & Son, of Reading; John Brandt, of Lancaster; and Ross Winans, of Baltimore.

All the engines in use in 1839, and for some time later, had single drivers, none of them having more than a single pair of wheels, exclusive of the pony truck. During the period from 1839 to 1854 the weight of new locomotives obtained gradually increased from about seven tons to about fifteen tons. A leading point of difference between the early Baldwin and Norris engines was the use of a crank axle on the former, and a straight axle on the latter. For some time opinions differed in regard to the respective merits of these devices, and the final decision was in favor of the straight axle, partly on account of the expense sometimes caused by the use of the crank axle, and partly because it was believed that straight-axled engines could be more promptly started. Three engines purchased from Eastwick & Harrison also had straight axles. They were considered the swiftest locomotives on the road, and they were, therefore, employed in hauling passenger trains. During the fifth decade four-wheeled engines were introduced. The locomotives made by John Brandt, at Lancaster, were very satisfactory. Two engines procured from Ross Winans were known as crabs. They were four-wheeled, had vertical boilers, and were specially intended for burning anthracite coal. They had the reputation of "pulling like elephants," but it was difficult to keep the flues in proper order, leakages being frequent, and on this account they were sometimes disabled on the road.

As with all other early American locomotives there were no cabs in 1839, and when their introduction was proposed a few years later, the locomotive engineers strongly objected to their use, for the reason that they believed the perils to which they would be exposed in case an engine was overturned or thrown off the track would be materially increased by confinement in a cab.

One of the greatest of the early difficulties experienced in the repair-shops at Parkesburg arose from the fact that the nuts and bolts used on the locomotives procured from a number of different establishments were of different sizes and patterns, every bolt having its own corresponding nut, and the adoption of effective remedies for this multiplicity of sizes and shapes proved very useful.

This difficulty was heightened by the tendency to unnecessarily increase the number of establishments from which locomotives were purchased, by the pressure of political influence, while state management prevailed. Other outgrowths of party management were the actual or threatened dismissal of prominent employés for partisan reasons, the occasional purchase of inferior bituminous coal, and an attempt to convert a locomotive into an anthracite coal burner which only resulted in spoiling a good engine.

THE PARKESBURG SHOPS

were located midway between Philadelphia and Columbia, and all general repairs of locomotives were made at them for years. The only provision at either end of the line was furnished by blacksmiths and helpers, who were in readiness to perform such labors as locomotive engineers considered necessary.

A pay roll of the Parkesburg shops for September, 1843, shows that the official title of the road then was the Columbia and Philadelphia Railroad (although at a later date it was styled the Philadelphia and Columbia Railroad, and the report of its superintendent for 1855 gives it that title). The number of employés was 31, including one manager, Mr. Edwin Jefferies, one foreman, thirteen machinists, three blacksmiths, one coppersmith, two file makers, one pattern maker, three carpenters, one stationary engineer, four assistants, and one watchman. The aggregate amount of the pay roll of these 31 men for that month was $1,087.88.

The pay roll of locomotive engineers and firemen employed on the Columbia and Philadelphia Railroad during the month of August, 1843, shows that their number was 40—twenty engineers and twenty firemen. The standard rate of wages at that time and for some years previous to and subsequent to that period was $2 per day for engineers and $1.25 per day for firemen, the time paid for being that in which actual service was performed, and all accounts being verified by affidavits. The total payments for that month were $990 for engineers and $674.36 for firemen. Of the twenty engineers two were employed on a night line, two on a fast line, and sixteen in running "burden" or freight trains.

Of the forty men in service at that time, only five are known to be living now (1886), and several were killed by accidents on the road. One of these accidents, by which an engineer and a fireman lost their lives, led to the introduction of

SAFETY CHAINS, CONNECTING THE LOCOMOTIVE AND TENDER,

on that road and others. The men were standing with one foot on the locomotive and another on the tender, when the coupling suddenly broke, and they fell to the ground, and were run over by the train. Previous to that time the coupler furnished the only connecting link between the locomotive and the tender.

Another novel incident led to

THE INTRODUCTION OF SAND BOXES.

It occurred on a section known as Grasshopper Level, a few miles east of the city of Lancaster, and happened during a season when grasshoppers were so numerous that, in addition to becoming a devouring pest on the adjacent farms, they impeded, and in some instances temporarily prevented, the progress of trains on the railway. One of the remedies adopted was to keep men stationed on the track to sweep the grasshoppers off, as they accumulated in immense throngs, but the aid derived from this expedient not being sufficient to fully meet the emergency, arrangements were made for the first time on that road to provide sand boxes.

THE PHINEAS DAVIS LOCOMOTIVES.

An extract from an early report of the Baltimore and Ohio Railroad Company, which is published in Hazard's Register of April, 1833, gives a detailed account of the results of experiments, continued during a period of 30 days, with a locomotive steam engine called the Atlantic, which had been constructed by Messrs. Davis & Gartner, of York, Pennsylvania, It is stated that these experiments were made "for the purpose of ascertaining, practically and conclusively, the applicability of steam power upon that road, and with the further view of testing its comparative expense and advantages with animal power." The engine is described as weighing 5½ tons, exclusive of water, and as having two cylinders, of 10 inches diameter each, with a stroke of 20 inches, and working on road wheels of 3 feet diameter. Its performances consisted of drawing five cars, weighing about 18 tons, at an average speed of about 12 miles per hour. But on several occasions a load of 30 tons, exclusive of the engine and tender, was drawn 13 miles within an hour. This engine was designed specially for speed, and the report said that the builders were then making a freight engine which was expected to draw 100 tons from 6 to 8 miles per hour. The Atlantic's performances were highly economical as compared with the horse power then used, as her daily labor involved only an expense of $16; while the total expense of the animal power needed to accomplish the same results was $33—a saving of $17 per day, or upwards of $500 per month.

This locomotive, Atlantic, was the outgrowth of the successful competition of Mr. Phineas Davis for a prize of $500 offered by the Baltimore and Ohio, in 1830, to the constructor of a locomotive which would draw 15 tons, gross weight, 15 miles an hour. An engine previously constructed complied with these conditions and its pattern was adopted, but the Atlantic was an improvement on the first machine. It is stated that Mr. Davis was a Quaker, and that his first locomotive was commenced in York in 1831 and taken to Baltimore in February, 1832. He was made master of machinery of the Baltimore and Ohio, and soon after completing the Atlantic he designed the Arabian, exhibited at the Chicago Railway Exposition of 1883. Shortly before it was opened a sketch of the Arabian appeared in the Washington Republican, which included the following extract:—

"Then Mr. Davis designed the Arabian. This engine was built at the company's shops, under the supervision of its designer. It went into service June, 1834. It has been carefully taken care of and repaired, and, with very little difference, is precisely the same engine that it was forty-nine years ago. It is a geared engine, having a vertical cylinder with walking beam. It has four driving-wheels, each thirty-six inches in diameter, or nearly one-half the size of the drivers used on modern passenger locomotives. The weight of the Arabian is thirteen tons, about one-third that of the modern locomotive. Its tractive power is 6,000 pounds. It used to have its fans connected with the exhaust, but these became broken, and no attempt has been made to restore them. With this exception it is the same engine as when first made. It is in active service at the Mount Clare yards, and works as well now as when first put on the road. It was for many years a passenger engine, drawing trains on both the Washington branch and the main stem. So far as could be learned it had never met with an accident, never jumped a rail or run off the track, with one exception. That exception was a notable one. Before it was finished Mr. Davis promised the workmen engaged in the shops—some three hundred—to take them and their families on the train drawn by the Arabian as far as it went, then to go to Washington and have dinner at Brown's (now the Metropolitan) Hotel. The Washington branch was then opened nearly to Bladensburg. The trip was made, William Duff being the engineer. Just west of Jessup's Cut, 13½ miles this side of Baltimore, the Arabian ran off the track. Mr. Davis was sitting with Mr. Duff when the accident occurred. The engine rolled on its side. Neither Duff nor anybody else on the train was hurt, even in the least, but Mr. Davis. He was killed. There seemed to be a special fate in the matter. Nobody could ever tell why the Arabian ran off the track. There was no evidence ever shown, although the fullest investigation was made, that any cause existed to throw it off."

After the death of Mr. Davis, the construction of locomotives was continued at Baltimore, by Ross Winans, at first in connection with a partner, and subsequently on his own account. He adopted a type which became popularly known as Ross Winans' grasshoppers, and subsequently built "crab" engines.

THE ROGERS LOCOMOTIVE WORKS.

Horatio Allen relates that he urged the members of the firm which built the first locomotive at Paterson, New Jersey, to engage in that business. It was then known as Rogers, Ketchum & Grosvenor, and the first locomotive, the Sandusky, was built in 1837. This locomotive had been built for the New Jersey Railroad and Transportation Company, but it was purchased by the Mad River and Lake Erie and shipped to Ohio. It had been commenced in 1835, after a considerable amount of preliminary work before that year. In connection with these efforts the Paterson, New Jersey Press, says:—

"After the success of the 'Sandusky' was assured, the firm of Rogers, Ketchum & Grosvenor continued to build locomotives. The next one was built for the New Jersey Railroad and Transportation Company, and was named the 'Arreseoh, No. 2.' This, which was larger than the 'Sandusky,' was also a success. For this, also, Mr. Swinburne made the plans, serving as draughtsman, pattern-maker, superintendent of construction, and foreman of foundry, blacksmith and machine shop. There was not another foreman beside in any department. The shop where the first locomotives were built was 40×100, two stories in height. From thirty to forty men were employed. After five or six engines had been built the works were greatly extended, until they were 40×200, three stories, of brick. Later, still further additions were made, and the demand for engines came in from every direction, from the east, west, north, and south."

An intelligent and experienced locomotive engineer, Mr. George Hollingsworth, who commenced running a locomotive in 1838, when interviewed by a representative of the American Machinist, in 1883, gave the following replies in regard to the early English engines used on American roads, and the characteristics of the locomotives first built at the Rogers Locomotive Works:—

"Q. What style were your English engines?

A. They were of the John Bull type. All the boilers that were built in England for the Camden and Amboy folks were built very nearly after that pattern. They were built with a waist straight to the back of the furnace. The engines were all inside connected, but they were good running engines. They were bad engines to work, though, for they were hard to reverse. They were built with a rock-shaft right in front of the cylinders, and the drop hooks came right through to where the shaft was, and there was nothing to catch but the straight hook and die. So when the engines were running you could not reverse them. The V hook was a little better in this respect, and a figure 8 hook was better still.

But the link was what ended the trouble in reversing. These early engines did good work for their size. The parts were made in England, and sent over here to be put together. Isaac Dripps put up the principal portions of them.

Q. What kind of engines were the Rogers works building when you knew them first?

A. They were small inside connected engines, with one pair of drivers and a four-wheel truck. They built very few of them. Mr. Rogers went to England on a visit, and when he came back they began building eight-wheelers, with two pairs of drivers connected. The first engines of this kind had the main rod connected to the crank-pin outside the back drivers. They were outside connected engines. Mr. Rogers was one of the first to advocate outside connected locomotives.

Q. Had these engines long exhaust pipes?

A. Yes; the long exhaust pipe was used for several years. Then, I think, old Jim Parks proposed the short exhaust pipe. He was a coal-pit engineer. When they tried the short exhaust pipe first it did not do. The steam spread before it reached the smoke-stack, and caused back lash. Then they put in the petticoat pipe, and that made the short exhaust pipe work all right.

Q. Had you any steam gauges in those days?

A. No; we had nothing but the spring balance, connected with the end of the safety-valve lever. They were Salter balance springs, imported from England. Then Orton, of Elm street, New York, who was a pupil of Salter's, began making these spring gauges, and he got all the trade."

NOTABLE IMPROVEMENTS OF THE LOCOMOTIVE.

CABS, SPARK ARRESTERS, EQUALIZING BEAMS, ETC.

An important improvement of American locomotives in addition to the bogie or locomotive truck and the pilot, devised by Mr. Dripps, was the construction of a comfortable cab or sheltering place for the locomotive engineer. A number of improvements in wheels and tires were devised. Springs were applied to break the force of jars and shocks. Great attention was also given to devices for arresting sparks, when wood was used as fuel (which was the general custom), so as to prevent the burning of haystacks, barns, and other buildings adjacent to the tracks. Much trouble arose from the lack of satisfactory spark arresters, and many attempts to remedy this defect were made. Corresponding difficulties had not arisen on the English roads, because there coke was usually the fuel used, while here wood, and frequently pine, fed the flames of the locomotive. The outpouring of sparks was frightful. Even after wire screens and effective methods of arranging them were devised, it was sometimes difficult to obtain the requisite amount of appropriate material, and in this as in many other matters, a series of new wants were developed for which no adequate provision had previously been made.

The original American locomotives were nearly all woodburners, and during a protracted period while spark-arresting inventions were undergoing a gradual process of evolution, with occasional failures, a great amount of destruction and annoyance was caused on some lines. Interwoven with this difficulty was a necessity for using smoke-stacks considerably higher than those now generally used,—too high, indeed, to pass under the roof of some wooden bridges or some overhead bridges,—and to overcome this defect the smoke-stacks of some locomotives were jointed or hinged so that they could be lowered when trains were proceeding over or under bridges. This requirement probably increased the danger that the locomotive would literally become a devouring engine. At all events it was customary on some of the covered wooden bridges for a watchman to follow every train, carrying a bucket of water for the purpose of extinguishing fires, and notwithstanding this precaution some wooden bridges were burned.

Increase of power was another desideratum, and it was reported in 1835 that the power of Baldwin engines then at work on the Philadelphia and Columbia, was thirty-five per cent. greater than that of two English engines which were also then in use. To Thomas Rogers, of the Rogers Locomotive Works, is given the credit of several important devices, one of which was making the driving-wheels of hollow cast iron, as a substitute for the wooden wheels with iron tires, and another the use of weights on the wheels to counterbalance the momentum of reciprocating parts. Joseph Harrison, of Philadelphia, in 1837, invented a useful method of distributing the weight of the engine evenly to the axle boxes by means of equalizing levers. In connection with this improvement and the circumstances that gave rise to it, a sketch of locomotive advancement says:—

"Mr. Henry R. Campbell, of Philadelphia, on February 5th, 1836, secured a patent for an eight-wheel engine with four driving-wheels connected, and a four-wheeled truck in front, and James Brooks, of Philadelphia, built for him such a machine, completing it May 8th, 1837. This was the first eight-wheeled engine of this type, and from it the standard American locomotive of to-day takes its origin. The engine lacked, however, one essential feature; there were no equalizing beams between the driving-wheels, and nothing but the ordinary steel springs over each journal of the driving-axles to equalize the weight upon them. It remained for Messrs. Eastwick & Harrison to supply this deficiency; and in 1837 that firm constructed at their shop in Philadelphia a locomotive on this plan, but with the driving-axles running in a separate square, connected to the main frame above it by a single central bearing on each side. This engine had cylinders twelve by eighteen, four coupled driving-wheels, forty-four inches in diameter, carrying eight of the twelve tons constituting the total weight. Subsequently, Mr. Joseph Harrison, jr., of the same firm, substituted "equalizing beams" on engines of this plan afterward constructed by them, substantially in the same manner as since generally employed."

INCREASE OF LOCOMOTIVE CAPACITY.

The limited powers of the very early locomotives, and the nature of the first advances, are indicated by the fact that Jonathan Knight, civil engineer of the Baltimore and Ohio in 1832, said: "In the year 1828 the power of the locomotive engine was no more than sufficient to propel itself up an ascent of 1 in 96 at the rate of 10 miles an hour, without dragging any load after it. In the course of two years after, however, such were the improvements made in this engine that it could draw up that ascent a train of cars weighing, with their freight, 17 tons, at 10 miles per hour. At the same time, it could draw on a level, at the same speed, $53\frac{4}{10}$ tons; at 15 miles per hour, 30 tons, and at 20 miles per hour, 15 tons."

It was considered quite a triumph for Mr. Cooper's Tom Thumb to draw a single passenger car of about the size and weight of a small street railway car. Of Mr. Baldwin's first practical locomotive, a contemporaneous account of its trial trip states that "there is every reason to believe that this engine will draw thirty tons gross."

One of the principal reasons why locomotives did not increase in size and capacity more rapidly arose from the defective nature of the railroads. It was feared that heavy locomotives would injure the roads then existing, and a striking proof of the necessity for caution was furnished by the fact that the Stourbridge Lion, after making a successful trial trip, was discarded, not on account of any inherent defect, but largely because it was considered too heavy for the line it was bought to serve, although the weight of this locomotive was only about six or seven tons. Similar difficulties were encountered in attempts to run six- or seven-ton locomotives over other roads.

The necessity of constructing locomotives of such limited size and capacity that they would not injure the fragile wooden-rail and strap-iron roads was so imperative that desirable improvements were postponed on this account. Nothing perhaps better illustrates the tendencies of this description which for a time prevailed than the fact that in 1833 Robert Stephenson, of England, wrote to Robert L. Stevens, of the Camden and Amboy, a letter deprecating the general inclination in this country to build light locomotives, and stating that he had completed the design of an engine, of which he gave a sketch, which weighed nine tons, and was capable of hauling "one hundred tons dead load sixteen or eighteen miles an hour on a level." He solicited the aid of Mr. Stevens in effecting sales of such a locomotive.

Primitive ideas of what a locomotive should be are indicated by the fact that when the Baltimore and Ohio advertised for American engines in January, 1831, it stipulated that "the engine, when in operation, must not exceed three and one-half tons' weight, and must, on a level road, be capable of drawing, day by day, fifteen tons, inclusive of the weight of the wagons, fifteen miles per hour."

The first annual report of the New York and Erie Railroad, dated September 29th, 1835, after discussing the grades then proposed for that projected line, and the improvements which had been made in locomotives, and referring to elaborate investigations by distinguished civil engineers, says: "The board of directors now have the gratification of announcing to the stockholders the following result, to wit: That loads of sixty tons gross (or, deducting the weight of the cars, forty tons net,) may be drawn in a single train from the Hudson river to lake Erie, and at an average speed of from twelve to fourteen miles to the hour; that with the rate of speed augmented one-half, a locomotive engine will nevertheless suffice to transport two hundred passengers and their baggage; that no stationary engine will be requisite to any part of the work; and that one, or, at most, two auxiliary engines (or pushers) will be requisite on the whole length of the line."

In an economic sense, the great advance made in the locomotive which outstrips all others, is in the increase of the weight of the trains which each machine can draw, and in this respect, although a very creditable and remarkable improvement had been effected prior to 1840, by which time some locomotives weighed twelve tons, and drew several hundred tons, the main part of the desirable work, in the direction indicated, still remained to be done.

LOCOMOTIVE POSSIBILITIES IN 1840.

That much had been accomplished, however, in comparison with the limited capacity and performances of 1830, is shown by the records made and the claims set forth by rival manufacturers in 1840. The Reading railroad was then a favorite field for competitive effort, and some of the most notable achievements occurred on its lines. A statement of its superintendent, Mr. G. A. Nichols, dated July 31st, 1839, said of a Baldwin locomotive that it had been in use fifteen months; that its performance was in every way satisfactory, and that it "drew at one time 45 cars, loaded with 150 tons of rails and iron, making in all 221 tons gross behind the tender, from Reading to Norristown, 41 miles, in 3 hours and 41 minutes, running time." This engine was presumably built in the early part of 1838.

A Norris engine drew over the Boston and Worcester road in 1840 a load of 150 net tons and 1,789 pounds, exclusive of 37 cars and a tender, which added 90 tons and 820 pounds to the weight drawn, and the movement was made partly over grades of thirty feet to the mile, which, although they taxed the capacity of the locomotive severely, were overcome by the free application of sand to the rails. This was considered an extraordinary achievement.

Another notable performance was reported of a locomotive constructed by Eastwick & Harrison, a rising firm of locomotive builders, located in Philadelphia, which discontinued operations in the United States on account of strong inducements to engage in similar pursuits in Russia. This performance consisted of the movement, on February 20th, 1840, of a train which had a gross weight, including cars and freight, but not including engine or tender, of 423 tons of 2,240 pounds. The net weight of freight was 268½ tons of 2,240 pounds. The trip was made from Reading to the foot of the inclined plane on the Columbia railroad, 54½ miles, in 5 hours and 30 minutes, or at the rate of 9.82 miles per hour. There were no ascending grades on this trip, however, with the exception of about 2,100 feet near its termination, graded at 26.4 feet per mile, upon which grade the train was stopped. On the return trip the locomotive drew a gross weight of 163 tons of 2,240 pounds, not including engine or tender, up a grade of 18.4 feet per mile. The engine weighed 11 tons, and its performances were considered unprecedented.

BALDWIN LOCOMOTIVES IN USE IN 1840.

One of the indications of the extent to which American railways had been supplied with locomotives previous to 1840, and of the names of the active roads then, is furnished by the fact that in an advertisement of Baldwin, Vail & Hufty, published in January, 1840, they state that there had then been delivered and were ready to be delivered, from the Baldwin Locomotive Works, the following number of engines to the companies named, viz.:—

In Pennsylvania.—Columbia and Philadelphia, 26; Harrisburg and Lancaster, 6; Philadelphia and Trenton, 4; Philadelphia, and Norristown, 5; Little Schuylkill, 2; Cumberland Valley, 1; Philadelphia and Reading, 2. *In New York.*—Utica and Schenectady, 12; Rensselear and Saratoga, 2; Long Island 2; Rochester and Batavia, 2; Buffalo and Niagara Falls, 1. *In Georgia.*—Georgia Railroad and Banking Company, 12; Central Railroad, Savannah, 4; Monroe Railroad and Banking Company, 3. *In New Jersey.*—New Jersey Railroad and Transportation Company, 5; Elizabethtown and Somerville, 2; Morris and Essex, 1. *In Delaware.*—Philadelphia, Wilmington and Baltimore, 4. *In South Carolina.*—Charleston and Hamburg, 6. *In Michigan.*—Detroit and Ypsilanti, 3; Adrian and Toledo, 2; Detroit and Pontiac, 1. *In Massachusetts.*—Boston and Providence, 3; Boston and Worcester, 3. *In Maryland.*—Elkridge and Annapolis, 2. *In Louisiana.*—Clinton and Port Hudson, 3; West Feliciana, 2; New Orleans and Nashville, 1. *In Indiana.*—Madison and Indianapolis, 3. *In Illinois.*—North Cross Road, 2. *In Mississippi.*—Commercial, 2; Mississippi, 1. *In North Carolina.*—Wilmington, 1, and Raleigh, 2. *In Florida.*—Lake Winnico and St. Joseph's, 2. *In Alabama.*—Mobile and Cedar Point, 1; Tuscumbia and Decatur, 1. *In Connecticut.*—Housatonic, 2. *In West Indies.*—Island of Cuba Railroad, 3. Total, 140.

CARS OF THE EARLY LINES.

At the outset car building was, if possible, in a more primitive condition than the construction of locomotives. Many individuals felt as free to adopt their own devices as if the vehicles were to be used on common roads. The first car used for transporting passengers on an English road resembled a small log cabin on wheels, and some of the earliest American cars were not much better. Another English device was to fit up on railway trucks a platform on which passengers could place their own carriages and sit in them while they were traveling. Some of the best of the primitive American passenger cars were stage-bodies put on trucks adapted to the rails, and a number of the expedients were of a less convenient and appropriate character. Pictures of some of the early cars represent stage-coaches, and others depict clumsy covered box-wagons, some of which had seats made of rough planks.

DEVELOPMENT OF A NECESSITY FOR "SPRINGS."

The National Car Builder says that "the cars for carrying passengers on the Liverpool and Manchester road in 1830 were without roofs, the body consisting of floor sills, and side and end framing boarded up. There were no springs, and the journal-boxes were bolted to the sills. In the following year springs were introduced for the purpose of protecting the rigid frame from the shocks of concussion. This improvement could hardly fail to be suggested by the important service rendered by springs in ordinary vehicles. The face of the car wheels were next made conical instead of flat, in order that they might get around curves more easily. A few years later came the class carriages, designated as first, second, and third class, the first having cushioned seats, but quite devoid of any special ornamentation. In addition to these there were 'mixed' carriages, so-called, having three compartments, the centre one being for first-class passengers and the other two for second class."

In a report of the Baltimore and Ohio for the year ended September 30th, 1831, Jonathan Knight, chief engineer, says: "It has been found absolutely necessary to the comfort of passengers, that carriages used for their conveyance should be mounted upon springs, or upon some equivalent elastic fixture. And the jars and concussions that would destroy the comfort of the passengers, become increased with a load of stone, minerals, or of agricultural products, or with any other loading having a less elasticity than persons, and although the articles of traffic may not be damaged, yet the effects upon the carriage and road will be injurious. The chief disadvantage to be apprehended from springs is their cost, but should this be more than returned in the increased desirability of the cars the investment would be profitable. Under these considerations it is recommended that a number of burthen cars shall be furnished with springs in order to test their advantageous use on such cars."

IMPROVEMENTS ON THE BALTIMORE AND OHIO.

Of cars used in early operations on the Baltimore and Ohio Mr. George W. Smith, in his notes on Wood's Treatise on Railroads, published in 1832, says: "The wheels of the wagons are made in accordance with the old-fashioned plan formerly pursued on some of the colliery railroads in Great Britain—the felloe being slightly conical, and curving towards the flange; this has, however, been claimed as a new and important invention. The novelty of railroads in this country, has induced many ingenious persons, connected with this railroad, to submit to the public, through the press, a number of devices purporting to be original; all of which (so far as they have been examined by the writer) are either in use, or have been proposed elsewhere, with two exceptions, namely, the mode of oiling the friction wheel of the wagon, claimed by Winans, and the plan of oiling common axles by means of a cork floating in oil; the latter was introduced by Colonel Long."

Other accounts of early operations at Baltimore state that in December, 1828, Ross Winans exhibited in that city the model of a car weighing about 125 pounds and running upon tracks. It was repeatedly loaded with deposits of 5 cwt. and two men, and the whole weight drawn by a piece of twine. This feat attracted much attention, as it was regarded as a remarkable demonstration of advantages that could be derived from the use of such anti-friction cars.

Another account says that the first car was like a market-car on wooden wheels. The next was a nine-passenger coach, with leathern braces and springs. At a later date Ross Winans made an eight-wheeled passenger car which he styled the Columbus. It was followed by novel devices, one of which was nicknamed by the workmen the Sea Serpent, and another the Dromedary, and then by improvements of the eight-wheeled car embodied in vehicles called Washington cars.

Baltimore was one of the early centres of car improvements. Of the first passenger car on the Baltimore and Ohio, a modern writer says that on this road "ran, first of all, a little, clap-boarded cabin on wheels, for all the world like one of those North Carolina mountain huts, with the driver perched on top of the front portico—driver, because the motive power then was one horse in tread-mill box."

It was succeeded by something like a market car on wheels, and subsequently by stage-coach bodies. An advance is described in the Baltimore American, of August 4th, 1830, as a device of Richard Imlay, of which that journal says that "the body of the carriage will contain twelve persons, and the outside seats at either end will receive six, including the driver. On the top of the carriage is placed a double sofa, running lengthwise, which will accommodate twelve more. A wire netting rises from two sides of the carriage to a height which renders the top seats perfectly secure. The whole is surmounted by an iron framework, with an awning to protect from sun or rain. The carriage, which is named the Ohio, is very handsomely finished."

Cars similar to the above were run upon the Baltimore and Ohio until a year or two later, when Ross Winans built what is reported to be the first eight-wheel car ever constructed for passengers. It was a large box, with a truck of four wheels at either end, and seats on top, which were reached by a ladder at one of the corners. Several improvements on this device speedily followed, and the one which met with most general favor resembled a combination of three coach bodies into one, divided into three apartments, and entered by doors on the side of each apartment. This device was succeeded shortly afterwards, on the Baltimore and Ohio, by cars embodying the plan, which has since been almost universally adopted, of having doors only at the front and rear of the car, and with an aisle between seats extending through the entire length of the car.

Much importance was attached to inventions of Ross Winans, which were reported to include the chilled-iron car wheel and other devices, which had a tendency to diminish friction. An engineer, writing in 1831, says: "A few years ago Tredgold estimated the friction at one in 130. N. Wood ventured as far as one in 200. Now the Winans car enables one pound to draw 450." Another account states that "the Winans wagon, invented by an American, was the model used both in the United States and England. The wheels were three feet high, and the wagon ran with a friction, according to a statement published at the time, of only 2½ pounds to the ton. The wagon would run, by its own gravity, on a railroad that inclines 5 feet 10¾ inches a mile, or one inch in 70 feet, which was considered one of the wonders of the age."

An early account of a trial trip on the Little Schuylkill and Susquehanna Railroad, opened in November, 1831, says that "two splendid pleasure cars, of Baltimore construction, containing about sixty persons, propelled by two horses each, and one of less dimensions, and lighter construction, with one horse, and two trucks for burthen, also containing passengers," were used.

An early description of cars says: "The railway cars or carriages are fitted with iron wheels, which, being cast in a *chill*, afford surfaces like hardened steel. Each wheel has a flange, or projecting rim, of about one inch in depth, which runs below the rail plates on the inner side of the tracks, and which effectually prevents the wheels from leaving the rails."

THE FIRST EIGHT-WHEELED CAR IN THE UNITED STATES.

In connection with the claim of Ross Winans to the invention of an eight-wheeled car, and suits brought against various companies for an infringement of his patents relating to this subject, a protracted legal controversy sprang up during the sixth decade. It was reported that if his claims had been fully sustained the amount of damages might have amounted to several millions of dollars, and that a quarter of a million of dollars was spent in the various car suits. The final decision was adverse to Mr. Winans, largely on account of evidence furnished by Gridley Bryant, projector and constructor of the Quincy Railroad, built in 1826, to the effect that he had used eight-wheeled cars in hauling extra heavy loads of stone on that road, which eight-wheeled cars he had formed by attaching together, by a platform and ring bolts, such trucks as were commonly used on his four-wheeled cars.

BARREL-SHAPED CARS.

Captain John Grant, who was officially connected with the Pontchartrain Railroad, running out of New Orleans, for a distance of 5½ miles, which was opened in 1830, says that on that line the coaches were of every design and pattern, and the appearance of a train of cars was so unique that in comparison with a train of the present day it was ludicrous in the extreme. He added that one of the most remarkable of the early coaches was used on the Charleston and Hamburg. This car was in reality a mammoth cistern laid on wheels. A door was cut in each end, and between the hoops were cut openings that served as windows. The seats were arranged longitudinally inside the car, which, as it stood on the rails, was an object of great curiosity to Captain Grant, familiar as he thought he was with every form of railroad cars in use in those days.

The following reference to these novel cars is made in the report of the South Carolina Railroad (which had originally been the Charleston and Hamburg), for the half year ending June 30th, 1840: "Another improvement, of perhaps greater importance, and which has originated with ourselves, is the *barrel car*—constructed both for passengers and freight. These are made with staves grooved and dove-tailed together, and supported by six iron hoops two inches wide by half inch thick —doors at both ends. The passenger car is 30 feet long in the clear, with portico at the ends 2½ feet long. The diameter in the centre is 9 feet, and at the ends 8 feet. The staves are 1¼-inch boards 5 to 6 inches wide, extending the whole length of the car. There are 20 windows on each side, 15×30 inches, glazed—the sash passing up overhead. The freight car, which has been in use about four months, is only 21 feet long—but others are being constructed 30 feet long, and will carry about 40 to 50 bales of cotton, or 15,000 pounds of other goods."

LIMITED CAPACITY OF FREIGHT CARS.

The freight cars used on coal roads before passenger traffic was commenced were of limited capacity. On the Mauch Chunk Railway each car weighed 16 cwt., and carried 32 cwt in addition.

On the Little Schuylkill, an early coal road of Pennsylvania, the cars used carried three tons of coal. The wheels were three feet in diameter, and two of them on one side were loose on the axle, which also revolved. This arrangement was adopted to lessen friction on curves. Stage-coach bodies were used for the conveyance of passengers.

Jonathan Knight, civil engineer of the Baltimore and Ohio, in 1832, said: "As the most economical ratio of weight between that of a car and its load is 1 to 3, and as the weight of a car to carry 3 tons is 1 ton, we shall, therefore, on the present occasion, assume the proper weight of each car to be 1 ton, and its freight 3 tons, as a general rule, upon great lines of railway."

It is stated that "the first freight cars put on the Boston and Albany were made just large enough to hold two hogsheads of molasses, and one director, named Hammond, was considered well nigh insane because he predicted that as many as eighty-five such freight cars of that pattern would at some time be needed between Boston and Albany. When the long cars were first introduced it was the custom of the company to number each end separately, so that the goods in one end of the car were billed under one number, and those in the other end were differently designated."

One of the most distinguished of American engineers says: "The cars first in use were small affairs. The 'burden cars,' as freight cars were then called, were boxes, a little larger than their width, and had a wheel at each corner. Three or four tons made a load for one of them. Cars and engines have been in course of improvement ever since the first were put on the track."

TWO-STORY CARS.

"In 1831," said John Stephenson, the veteran builder of horse cars, to a New York Tribune reporter, "I designed and built the first tram-car of the first railway for street service in this country or abroad. The car consisted of three separate compartments, each compartment holding ten persons, and being entered by separate doors, on the side, from a guard-rail. Seats were provided on top of the car for thirty more persons. The car was very much like the English railway coach, though it was considerably lower. It was hauled by a team of horses, the conductor remaining outside on the rail, rain or shine. The company for which it was built was called 'the New York and Harlem road,' running from Prince street, on the Bowery, along the line of the Bowery to Fourteenth street, thence along the line of the present Fourth avenue to Yorkville and Harlem."

This style of car, or something similar, was introduced on a number of the early railway lines while horse-power was being used on them. A description of a Kentucky railway, opened about 1838, says that "the cars were two stories high, and very curious-looking affairs. The lower story was inclosed, and set apart for the use of ladies and children, while the upper story, being open, was generally occupied by men; but in warm weather many ladies preferred to ride up stairs, as they called the top story."

PASSENGER CARS ON THE CAMDEN AND AMBOY.

The first passenger cars used on the Camden and Amboy were built at Hoboken, of a style closely resembling the English compartment car of that period, or a three-bodied coach. They held about twenty-four persons, and presented a neat and attractive appearance.

MISCELLANEOUS DEVICES.

Of the passenger car first placed on the West Chester Railroad, a short branch of the Philadelphia and Columbia, opened in 1832, a correspondent of a West Chester journal gave the following account in 1879: "The first car put on the track was built in Wilmington, Delaware,—a four-wheeled one with five seats inside, running across the whole width of the car. The driver's seat was of equal length and but little elevated above those inside. Each seat was ample for five persons. There being a driver's seat at each end, the seating capacity was sufficient for thirty-four persons besides the driver. Along each side, outside the car, was a platform nine inches wide, affording standing room for twenty persons. After the thirty-four passengers had taken their places other comers were admitted only on sufferance, and although they paid fare they had to seek their own comfort,—rather a forlorn hope,—the only solace being the consideration of a ride on a railroad;—a slight improvement on 'riding on a rail.' There was not an apology for a spring about the car to relieve the monotony of the incessant jar. Passengers complained of the tremor causing their heads to itch. The oldest physician now living in West Chester, after he had ridden a few miles out and returned, gave it as his opinion that the constant jarring might be productive of concussion of the brain. A joker within hearing remarked that 'if Dr. T's theory is correct we shall soon be a community of *addle-pates*.' The car was drawn by one horse, of which John Griffith (old Griffy as he was familiarly called), was the driver."

Of the cars used on the Philadelphia and Columbia on the day it was formally opened, in 1834, it is stated that "there were two trains, each consisting of thirty four-wheeled cars, each car seating sixteen persons, eight on a side." Some of these cars were constructed by stage-coach builders.

Of the cars which passed over the Portage Railroad about 1834, Mr. W. Milnor Roberts who had charge of its operation, says:—

"The freight cars were all four-wheeled, weighing from three to three and a half net tons each, or six thousand to seven thousand pounds. The passenger cars first used were of the primitive formation, designed and put upon the road by Mr. Lot Dixon, one of my assistant engineers. They seated comfortably twenty-five persons inside, and, like the interior of a modern street car, accommodated an indefinite number outside."

On the Philadelphia, Germantown and Norristown Railroad cars of the stage-coach pattern were at first used. Of later devices one of its early employés says that the company "adopted a new form of coach, more nearly approximating the modern pattern of a steam railroad car. These were constructed by joining two of the old carriages together, making an eight-wheeled car, with a door at each end; and a passage way through the middle."

He adds that two of the new eight-wheel cars "were twin cars, and were named the Victoria and the President. They had each a bar room at one end and a ladies' saloon at the other. The body of the car was fixed up with seats along the sides and in the middle. They were models of elegance and comfort."

Of the freight cars used on the Petersburg Railroad, of Virginia, in 1835, a report states that "new covers had been obtained," which indicates that the English practice of using tarpauling was adopted, as a substitute for the box cars.

Mr. W. Milnor Roberts, in his reminiscences of early railways, says: "I think it was in 1835 that I went with Mr. Norris to Mr. Imlay's car shop, on Bush Hill, Philadelphia, to examine the first eight-wheeled passenger car, as I understood. I pronounced it just the thing for the Columbia railroad, which abounded in curves. Mr. Imlay remarked that I was the first civil engineer who had said it would succeed. It was soon after placed upon the Columbia railroad. I had the honor to have a similar car, which was placed on the road the same year, named after me by the authorities in charge of the road, without my knowledge or saying by your leave. Eight-wheeled passenger cars in those days were regarded as grand affairs."

About the period named, or soon afterwards, eight-wheeled passenger cars were placed on a number of the progressive lines, and a few years later their use became quite general.

SLEEPING CARS.

Many accounts of the origin of the sleeping car have been printed, but one of the earliest references to such a device is contained in the following article, which appeared in the Baltimore Chronicle, of October 31st, 1838:—

"The cars intended for night traveling between this city and Philadelphia, and which afford berths for twenty-four persons in each, have been placed on the road, and will be used for the first time to-night. One of these cars has been brought to this city, and may be inspected by the public to-day. It is one of the completest things of the kind we have ever seen, and it is of beautiful construction. Night traveling on a railroad is, by the introduction of these cars, made as comfortable as that by day, and is relieved of all irksomeness. The enterprise which conceived and constructed the railroad between this city and Philadelphia cannot be too highly extolled, and the anxiety evinced by the officers who now have its control in watching over the comfort of the passengers, and the great expense incurred for that object, are worthy of praise, and deserve, and we are glad to find, receive the approbation of the public. A ride to Philadelphia now, even in the depth of winter, may be made without inconvenience, discomfort, or suffering from the weather. You can get into the cars at the depot in Pratt street, where is a pleasant fire, and in six hours you are landed at the depot in Philadelphia. If you travel in the night you go to rest in a pleasant berth, sleep as soundly as in your own bed at home, and on awakening next morning find yourself at the end of your journey, and in time to take your passage to New York if you are bent there. Nothing now seems to be wanting to make railroad traveling perfect and complete in every convenience, except the introduction of dining cars, and these we are sure will soon be introduced."

THE OLD TIOGA EIGHT-WHEELED PASSENGER CAR.

At the Chicago Railway Exhibition of 1883 one of the exhibits was an eight-wheeled passenger car built in 1840 for the Tioga Railroad, by the Harlan & Hollingsworth Company, of Wilmington, Delaware. It had been in service from that time up to the date of the exposition, and its arrangements showed that marked progress had been made in its construction, although it lacked a number of useful modern improvements. The National Car Builder, in noticing it, said:—

"The seats are of the same pattern as the common seats of to-day. Their frames are iron and their arms of walnut, the upholstering being plain and of leather. The body of the car has the following dimensions, viz.: 8 feet 4 inches by 6 feet 4 inches by 36 feet. The timbers are about the same as those put in to-day, excepting that the end sills are mortised into the side sills. The body is supported by no springs aside from the ordinary rubbers in the pedestals. On the original trucks, which served for twenty-eight years, the wheels were outside of the bearings. The car is fitted with the ordinary freight drawbar and chain brakes. The only ventilation afforded is that by means of a 10-inch flue in the centre of the car. Light is supplied by two candles, one in each end of the car. There are no closets, lavatories, or water coolers in the car. One stove is furnished in the winter. A curious feature about the windows is that they do not raise, the panels between the windows being raised instead. This feature is, we believe, still to be found upon some other roads. This antique car originally cost $2,000, and has a recorded mileage of 1,100,000 miles."

ARRANGEMENTS FOR HEATING CARS.

On some of the early lines, in northern latitudes, no arrangements for heating the passenger cars, whatever, were made. Others had stoves, of which a writer in the Boston Transcript gives this racy description: "And the stove! What a pleasure it was to hear the wood crackling and snapping, and to see the glowing cheeks of the honest old stove, as he sat sedately and without ostentation in the centre of the car, blushing in rustic self-consciousness at being the cynosure of every eye, and the wished-for Mecca of successive rows of shivering passengers, from those in the remotest and most frigid corners of the car, even to those who sit, freezing, but one seat removed! It was hot enough, goodness knows, to the favored passengers whose seats abutted immediately upon the stove, but why there should have been heat nowhere else must ever remain a mystery. There was no hole or crevice through which the heat might escape, and no crevice or hole through which the outside air might come in as an adulterant of the caloric; still was the heat concentrated in one place, and the coolness elsewhere disseminated. Hence it will be seen that there were two distinct climates in each car, instead of the monotonous temperature of this day of heaters and kindred abominations."

DEVICES FOR LIGHTING CARS.

It is doubtful whether, at the outset, any arrangements were made for lighting the interior of some of the passenger cars used. But when the desirability of such an accommodation was recognized it was considered sufficient, during a comparatively protracted period, to furnish one or more candles. Of an eight-wheeled car built in 1840, which contains many improvements, and probably all that had been general at that time, it is stated that "light is supplied by two candles, one at each end of the car." The writer remembers traveling by night in 1867 on an accommodation train in an inferior old passenger car on the Camden and Amboy, which had a side-door opening, and which was particularly noticeable for the great variety of styles of lamps and lighting apparatus which had been introduced at various stages of progressive improvements. Either because they had successively failed, or for other reasons, a resort to the early expedient was renewed, and the car was again illuminated by two candles.

CAR SEATS.

Of seats of some of the early cars it is reported that they were plain pine boards, but transitions toward more comfortable arrangements were soon commenced. On this subject the Boston Transcript says: "There were no soft, effeminate cushions in those grand old days; no cunningly contrived easements to back and body and legs were imposed upon the traveler, to rob him of his manliness and his energy and his powers of resistance; everything was constructed upon heroic principles; everything was so ordered that even death, at any time likely and at all times probable, was robbed of half its terrors, and oftentimes looked upon with complacency, if not with longing."

TREAD-MILL HORSE-POWER EXPERIMENTS.

At the very earliest stage of development on some of the lines several novel expedients were adopted. One was the use of a car with sails, to be propelled with wind, which was soon found to be too unreliable. Another, resorted to on the Baltimore and Ohio, the Charleston and Hamburg, and some of the New England railways, was the use of horse power created by the operation of a horse on a tread-mill, in the same car that carried passengers. The object of this device was to gain greater speed from horse power than could be extracted from horse movements on a track, but it was quickly abandoned. On the Boston and Lowell such an experiment was specially unfortunate, because, when a party of editors were riding in the car it ran into a cow, and the passengers were thrown down the embankment, and afterwards had to endure many jokes about being cowed.

NOVEL INCIDENTS ON EARLY RAILWAYS.

RAILWAY movements are at all times invested with deep interest to those who are responsible for results, and the operations on some of the early lines were peculiarly exciting on account of the lack of experience, the absence of a number of the appliances and safeguards which have since been considered indispensable, and the crude nature of the tracks, locomotives, and cars.

An English Engineer forcibly says that "the railway of the present day is in principle what it was at the outset; but it differs in detail from the original as much or more than the skewer that fastened the dresses of the ladies in Queen Elizabeth's time from the pin of the present day, or the carpets of this era from the rush floors of that. The progress has been gradual, but not slow."

SOME OF THE ORIGINAL DEFECTS

grew out of the peculiar circumstances under which the primitive lines were called into existence, and the ends they were designed to serve. One class of roads was intended mainly to carry freight for the owners of the line, and if this purpose was served other matters were of comparatively little importance. This remark applies to the early coal roads, and even on the Philadelphia and Reading, which also engaged extensively in other business, it is stated that there was a period when coal trains were given the right of way in preference to passenger trains. There were also some roads, belonging to private companies, which commenced operations under a system like that adopted on the railways built by the state of Pennsylvania, viz., the companies did not aim at furnishing either passenger or freight cars, and only supplied the roadway and motive power. This limitation had an effect analogous to that arising from the application of a similar principle to turnpikes, inasmuch as the company might, in various contingencies, become anxious to reduce expenses, even at the risk of subjecting rolling stock to unnecessary wear and tear. A number of important lines were built partly with aid, more or less liberal, from state or city governments, which was given chiefly for the purpose of drawing trade to some particular centre, and if this object was promoted in a satisfactory degree other shortcomings were usually condoned.

OPPOSITION ENCOUNTERED.

In addition to the usual forms of opposition which many modern railways encounter, special causes of distrust and hostility existed when the entire undertaking was novel. In portions of Pennsylvania the fear that the use of horses would be greatly restricted was a leading incentive to active antagonism. In other places champions of pre-existing canal systems desired to prevent rivalry. There were some localities in which the adverse influence of rich stage proprietors was keenly felt, and their efforts to crush a dangerous and destructive competition materially increased the difficulties of some of the early projectors. In some instances stage routes and appurtenances that had been sold for large sums soon ceased to be profitable after competing railways had been completed. There was also a considerable number of substantial and conservative citizens who opposed the innovation on principle, although they reaped a large share of the benefits conferred. Josiah Quincy, in discussing this phase of the pioneer railway movements, describes town meetings which passed resolutions denouncing projected lines as incalculable evils, and he says that "the believer in railroads was not only to do the work and pay the bills for the advantage of his short-sighted neighbor, but, as Shakespeare happily phrases it, 'Cringe and sue for leave to do him good.'"

In Mr. George W. Smith's additions to Wood's Treatise on Railroads, published in 1832, he says that on the Baltimore and

Ohio "an unfortunate cow (according to the inveterate habits of these animals) crossed the road when a train was passing, and persisted in the attempt to arrest the progress of the car. The melancholy fate of this proto-martyr of the opposition, excited great commiseration among some of the canal advocates, who bewailed her untimely end in many a newspaper article. On the South Carolina Railroad a negro placed himself on the top of the safety valve of the locomotive engine during the absence of the engineer; it proved no seat of safety to him; and, resenting the indignity, blew poor Sambo sky-high."

DEFECTS OF THE TRACKS.

The plan of constructing railways on stone sills, which had been adopted in England, led to a serious derangement of the tracks, and materially increased some of the difficulties of early operations. The frost cracked and broke many of these solid foundations, and the position of others was shifted, so that a new system of construction became necessary. All the early devices were very defective, but the stone from which so much had been expected proved even less satisfactory than the supporting wooden rails or stringers, which quickly decayed or wore out.

The practice of sanctioning sharp curves was resorted to with extraordinary frequency, particularly on lines which were to be run by horse power at the outset. The chief reason for this course originated in a desire to avoid the expense required for the construction of tunnels, bridges, and deep cuts or high embankments, but the influence of citizens who favored the adoption of particular routes for the promotion of private purposes was also an important consideration. An account of an early road in Kentucky says that "it is very crooked, because the engineers who surveyed it were averse to crossing streams on bridges, so they went around the streams, alleging that it was an advantage to have the road crooked, so the conductor could look back, and see that his train was all right."

As flat iron bars were used as a substitute for iron rails on a very large proportion of the mileage operated they furnished a fruitful source of anxiety and danger, and caused delays and accidents of one kind or another, some of which were of a decidedly serious nature. An early conductor reports that on the line with which he was connected "it frequently happened that the strap rails would get out of place and curl up at the ends, forming 'snakes' heads.' Every train carried a good sledge-hammer, and whenever it passed over a loose rail and left a snake's head in its wake, the conductor had to stop the train and hammer the loose rail into place." Sometimes a snake head would fly up, and the rail would go through the car and shatter it. Occasionally a passenger would get hurt. "Snake heads" were as prominent a feature of early railroading as snags in steamboat operations on western rivers. The relative lightness of the locomotive and rolling stock, and imperfections of the track, made derailments or jumping the track comparatively common. The cars were, at the outset, destitute of springs, brakes, and buffers, and such appliances were only supplied and improved by comparatively slow degrees.

DIFFICULTIES ON EDGE RAILROADS.

While the roads supplied with edge rails were decidedly superior to those on which strap rails were used, serious and constant difficulties arose on them, particularly from the keys or wedges used to keep the rails in proper position in the chairs becoming loose; from the tendency of the stone blocks on which the chairs were placed to be shifted, and alternately elevated or depressed by frosts or other atmospheric changes; from the danger that rails would be broken; and from the frequency of tracks spreading, on account of the relatively small number of ties used. It was part of the system pursued on the Columbia and Philadelphia Railroad, while edge rails were used on it, to have track walkers constantly at work, by day and night, who were specially charged with the duty of tightening the keys used in the chairs. Each mile was assigned to a man for such operations during the day, and a man for night service. He carried a leather pouch containing keys, so that substitutes for those which were lost or broken could be supplied, and a long-handled hammer, to be used in tightening keys or wedges when they were loosened.

In regard to the effect of the stone blocks and scarcity of ties, the superintendent, Joseph B. Baker, in a report for the year ending November 30th, 1855, says: "Every exertion has been made to keep the old portion of the south track in passable condition, and it is a source of satisfaction that we have been enabled to strengthen it, so as to allow the passage of the large and increasing business now thrown upon it. If the old rail (edge rail) had not been made of the best iron, it would have been impassable long since. Wherever it was possible to put in additional cross-ties between the stone blocks, both in straight lines and curves, it has been done, and as long as the frost does not affect the ground the track will be reasonably safe, but in hard-freezing weather the cross-ties are disturbed, and the stone blocks remaining permanent, the rails are thus raised from the blocks, lessening the bearings, and sometimes causing the rail to break when the train comes upon it.

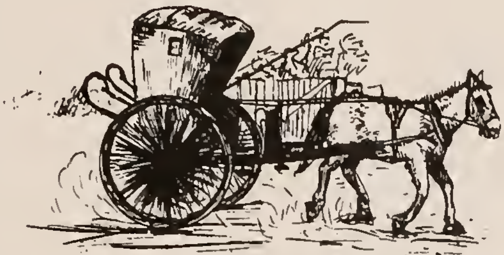
The same effect is produced when the frost leaves the ground, the bearings being merely reversed, the rail resting upon the blocks, while the cross-ties sink below. This operation has been going on for the last twenty years, the engine making a waved line of the rails, and the repair men making them straight again, and it is no wonder that they cannot be relied upon for carrying with safety the present trade."

HOW ROADS WERE OPERATED BEFORE TELEGRAPHIC COMMUNICATION WAS AVAILABLE.

As telegraphic communication available for railway service was not established until about 1850, various methods were adopted for ascertaining the location of belated trains and relieving them. On roads on which comparatively extensive movements were made a locomotive was kept ready for the use of relief parties at all hours of the day and night. The preparations for any probable emergency were as complete as possible, but it will readily be seen that the absence of telegraphic communication materially increased the difficulties of operation, inasmuch as the first duty, when delays occurred, was to start on a voyage of discovery, and it was necessary that all appropriate preparations for the commencement of such explorations at any moment should be constantly in a state of readiness. This system was in force on the Columbia and Philadelphia Railroad. When a passenger train failed to make its appearance at about the proper time (there was no strict schedule, but engineers of passenger locomotives were expected to be as expeditious as possible), a locomotive and crew were dispatched to its relief, and similar steps were taken when freight trains were delayed. The task was entered into with a spirit similar to that which animated the volunteer firemen of the olden time. The crew generally consisted of eight or ten persons, who carried with them whatever was deemed necessary to repair an injured locomotive or return it to the track if it had been derailed, and as there was danger of a collision if proper precautions were not taken, some of the crew were sent ahead when curves were approached to see whether progress could be safely continued. After the belated train was reached, if the difficulty arose from derailment, then much more common than at present, the usual phenomenon was developed of passengers acting under the supposition that they had a much better understanding of the proper method of returning a derailed locomotive to the track, than the men who devoted a large portion of their lives to such labors. If the detention was caused by derangement of any portion of the engine temporary repairs were made as quickly as possible.

PRIMITIVE SIGNALS.

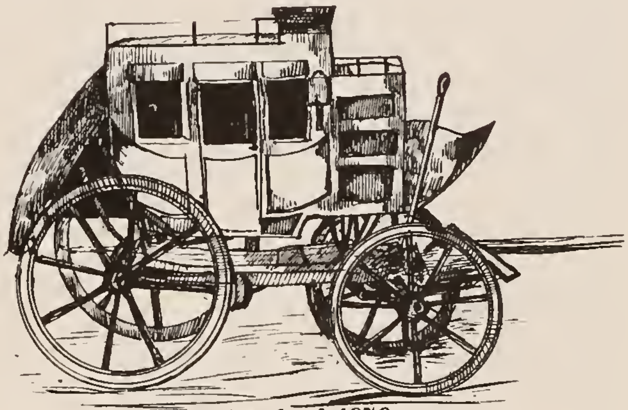
In the absence of the telegraph, and the lack of any established system of signaling, novel methods for conveying information were devised. It is said that the New Castle and Frenchtown had a primitive telegraph system in operation as early as 1837. A description of it says that "the poles were of cedar, quite like those now in use, and had cleats fastened on them, forming a sort of Jacob's ladder. The telegraphing was done thus: The operator would go to the top of the pole forming his station, and with his spy-glass sight the next station in the direction of the approaching train. If the train was coming, and the signal showed a flag, it meant all is well. If a big ball was shown, and no train in sight, it signified an accident, or delay of the steamboat. These signals were methodically



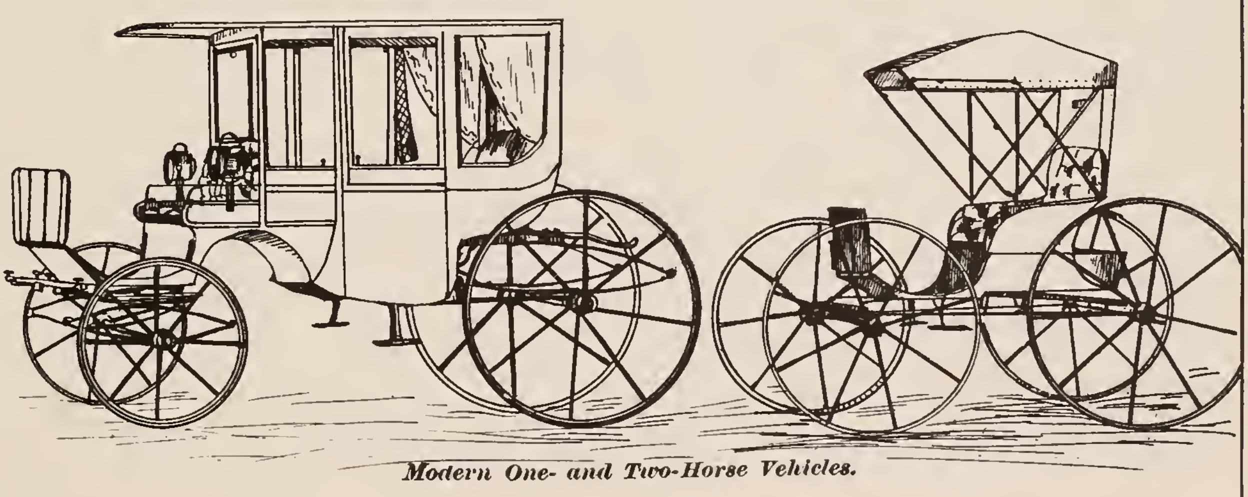
One-Horse Chaise.

Family Coach of 1776.

Stage Coach of 1820.



Stage Coach of 1870.



Modern One- and Two-Horse Vehicles.

exchanged until an understanding was had from one end of the road to the other."

The methods of communicating intelligence from one part of the train to another, and of giving warnings or signals from the locomotive, have been greatly improved. One of the early engineers on the Philadelphia, Wilmington and Baltimore says that on that road, before whistles were applied, "signals of danger, &c., were given by raising the valve stem on the dome with the hand, and allowing the steam to escape with a sudden, loud, hissing noise."

One of the first conductors on the Philadelphia, Germantown and Norristown says: "The manner of stopping trains then, in contrast to the modern system of simply pulling a bell rope, was something altogether novel. The conductor ascended a ladder to the roof of a car, and then ran forward to within hailing distance of the engineer, to whom he imparted the signal verbally. There was a great deal of briskness required of a conductor in the old days, and running along the tops of cars on a dark night was not as comfortable a task as one might wish for. There were no bell ropes, and the steam whistle had not been thought of." He also says: "The first practice of railroad signals that I remember was a system of conveying a sign to the engineer by a movement of the fingers. For instance, if I wanted to stop at the Falls I held up one finger; Wissahickon, two fingers; Conshohocken, three fingers, and so on."

On another road a device was used which enabled the engineer, by running up a flag on the tender, to notify brakemen that they should apply brakes.

DEFECTIVE BRAKE POWER.

Many troubles or inconveniences arose from defective brake power. At one time the chief reliance was upon the activity of the engineman in checking the speed of the locomotive, but this was often insufficient. It is stated that on the New Castle and Frenchtown Railroad the braking of the train when near the station—Frenchtown or New Castle—was done at the signal of the engineman by raising his safety valve. Then the old colored servants (slaves) would rush to the train, seize hold and pull back, while the agent would stick a piece of wood through the wheel spokes.

Of the primitive brake power on the Philadelphia, Germantown and Norristown one of the early employés of that company says that "the speed of a train was slackened by what was termed a foot brake, operated by the pressure of a man's foot on a spring and lever." A New England writer refers to "those dear old hand-brakes, which gave one, when approaching his station, such a jolly stirring up and never let up until he was landed wide awake on the platform." There was always rude jolting when trains stopped or started, and it frequently was tantamount to a shock scarcely less severe than would be caused on a superior modern train by a collision.

It is said that the primitive buffers on the New Castle and Frenchtown "were formed of the side sills extending past the end of the car, these ends being cushioned with hair covered with sole leather."

SUBSTITUTES FOR LOCOMOTIVE HEAD-LIGHTS.

Horatio Allen states that when the South Carolina Railroad had one hundred miles of track prepared for use, operations over such an extensive line were then unprecedented. In making prospective arrangements for this unusual undertaking one of the first things that occurred to him was that the locomotives would have to run by night as well as by day, and in the absence of a head-light he built an open platform car, stationed in front of the locomotive, a fire of pine knots, surrounded with sand, which furnished the requisite illumination of the route traversed. On some of the other lines no substitutes for head-lights were used. But night trips were, as far as possible, avoided, and it was considered a hardship when the carrying of mails necessitated them, and when no extra compensation was given for such service.

One of the current items of newspaper intelligence in August, 1840, was the following: "The Boston and Worcester Railroad Company are preparing a very bright head-light with powerful reflectors, to be placed in front of a locomotive, which is to run on that road after night. The transportation of freight by night is a very material gain in point of time, and diminishes the chances of collisions, while the slow rate of travel enables a locomotive to draw heavy loads without injury to the road."

HORSE POWER *vs.* STEAM POWER.

During the period when transitions from horse power to locomotives were progressing, and some of the locomotives were not very reliable or powerful, there was considerable diversity of opinion in regard to the merits of the two motive powers. At that time stage-coach operations had been brought to a high state of advancement, and there were occasional trials of speed, in which, on account of a temporary disability of the locomotive or other causes, the iron-horse was beaten. Such an incident occurred in a trial of Peter Cooper's locomotive, on the Baltimore and Ohio, and there are reports of similar contests elsewhere. As the number of locomotives was very limited, the disability of an engine was, in some instances, followed by a temporary resumption of the use of horses.

SLAYMAKER'S BULL.

Reports of an incident on the Philadelphia and Columbia Railway, in which the right of way was contested by an irate bull, were widely circulated, and for years this singular conflict and its results were often referred to as typical of the resistless power of the locomotive. The story, as told by Henry Willis, a gentleman who claims to have been a witness of the occurrence, is as follows: "One mile east of Leaman Place, a farmer named Slaymaker, whose barnyard was at the foot of a thirty-foot embankment, had a three-year-old bull, that showed its approval of railway matters by bellowing in the most unearthly manner at each train, much to the amusement of the passengers. I had occasion to go to Parkesburg early one morning, and with this intent took the four o'clock early freight, which was made up of twelve open cars, each loaded with four hogsheads of whisky, manufactured by Benjamin Herr, of Manor township, Lancaster county. Slaymaker's bull heard the engine coming, got on the track, and headed for the enemy. I was on the engine at the time, and feared going over the embankment. I called to the engineer to open the throttle wide. The engine darted forward, and the bull met the enemy sooner than expected, and was hurled to the bottom of the embankment. Cowcatchers were not in use then; simply a bumping block. Ever after the bull would shake his head and bellow, but he gave us a wide berth."

IMPECUNIOSITY.

There are doleful accounts of the pitiful state of impecuniosity to which some of the lines were reduced. Cash being exhausted, and receivers' certificates not having been invented, when operations proved unprofitable there was no basis for credit. An early employé of the Philadelphia, Germantown and Norristown, which subsequently became one of the most profitable short lines in the country, reports that he was obliged to buy grease to oil the axles with his own money. An old engineer on a New England road "relates how men were sometimes put on the tender, with a saw-horse and saw, to cut the wood to make steam for the trip, because there was no supply on hand, and no money and no credit to buy any. It is said that an official once gave up his gold watch as security when a train was seized for debt while *en route*."

Poverty, or lack of means, was a chronic complaint with so many of the early lines, that if a few notable successes had not been scored, and if state and city governments had not rendered timely aid to some of the most important enterprises, the rapid extension of the system would have been jeopardized. It is probable that the life of a considerable number of unprofitable lines was only perpetuated, because, after large sums had been expended upon them, investors and creditors of various grades concluded that it was better to make additional advances, even at the risk of losing the amount of the new outlays, than to sacrifice the entire capital.

PAUCITY OF FREIGHT TRAFFIC.

One of the noticeable features of early operations on northern lines was the small amount of freight traffic. It was, relatively, easier to attract passengers than to obtain consignments of merchandise or staple products, except on roads that traversed coal-mining districts or cotton-growing regions.

Of a prominent Massachusetts road it is reported that a motion was made at an annual meeting to let the privilege of carrying freight on its lines to some responsible person for $1,500 a year. Of freight operations on the Baltimore and Ohio a report dated October 1st, 1831, stated that on thirteen miles of road in operation since the previous January, only 5,931 tons of freight had been carried. During the same period 81,905 passengers had been carried.

The following statement of the early business of the Camden and Amboy Railroad, located on one of the best natural routes in the country, inasmuch as it was the leading thoroughfare between two of the most populous cities of the United States, indicates at once the paucity of freight traffic (which was partly due on this line to high charges and partly to the existence of convenient adjacent water routes), and the small amount of traffic of any kind that could be procured:—

	Passengers.	Merchandise. Tons.	Receipts.	Expenses.	Net earnings.
1833	109,908	6,043	$468,142	$287,091	$181,050
1834	105,418	8,397	546,993	313,261	233,731
1835	147,424	10,811	679,463	317,491	361,971
1836	163,731	12,508	770,621	363,344	407,276
1837	145,461	10,642	731,995	359,510	372,484
1838	164,520	11,765	754,989	355,249	399,740
1839	181,479	13,520	685,329	258,043	427,286

At a comparatively early period of the operations of this road it was considered an important event when the demand for cars to move freight increased to a requirement for forwarding 90,000 pounds in a single day.

A serious obstacle to immediate success on many of the early lines arose from the extent to which the practice of dispensing with the aid of common carriers of any kind in land movements had been rooted in many communities. Aside from the travel on stage routes, and the hiring of teams to carry merchandise over a few leading thoroughfares, nearly all those who wished to make journeys or move merchandise used their own teams or borrowed horses or vehicles.

EMPLOYÉS OBTAINED FROM STAGE ROUTES.

Of the antecedents of the employés selected as trainmen on a number of the early railways, and especially those constructed in New England, Mr. William S. Huntington says that many of them had previously been connected with stage-coach operations. He says: "Some were employed as conductors, others as station agents, baggage masters, firemen, etc., etc. Their former occupation made them robust and their training gave them that keen, attentive watchfulness which admirably fitted them for their new calling. They were called upon to fill every conceivable position in operating railroads. They were promoted from time to time, and firemen soon became engineers, baggagemen were soon collecting fare, conductors were made superintendents, engineers were promoted to be master mechanics, and so on through the whole list, and as fast as railroads were built the stagemen were called upon to operate them. There was a great deal of ignorance in railroad management in those days, but not as much nonsense as there is now."

There was peculiar propriety in recuiting employés from the stage routes, as they were the principal sufferers in the way of losing previous employment by railway operations. In some localities staging was combined with railroad operating by companies who made it part of their business to take up or put down passengers at any convenient point in the towns or cities near their termini. This was done in Boston and Albany and probably other places, the system being applied to passenger traffic that is applied now to light freight traffic by the express companies which act in co-operation with railway companies.

EARLY LOCOMOTIVE ENGINEMEN.

On some lines great difficulty was experienced in obtaining reliable locomotive enginemen. On account of the exposure to which they were subjected before cabs were furnished, and comparatively low wages, few machinists who understood engines cared to continue in the business. Smart young blacksmiths were found to be the best class to select from by some roads. In other districts young men trained as farmers, and accustomed to miscellaneous farm labors, but not experts in any class of mechanics, proved most serviceable. The duties imposed were in several respects peculiarly responsible and onerous, inasmuch as the enginman was expected to understand the machine he was operating sufficiently well to give directions for a considerable proportion of the requisite repairs, which were often made by men who had no other training than as blacksmiths. Instances of defective knowledge on the part of some of the inexperienced enginemen were by no means uncommon, and occasionally ludicrous blunders were made, but, as a rule, a better comprehension of the locomotives used was then necessary than is requisite now, on account of the marked improvement in systems of repairing; and if a train was derailed it frequently became the duty of the engineman to set matters right without aid from a wreck train.

ECONOMIC RESULTS OF EARLY RAILWAYS.

PREVENTION OF ICE AND FRESHET BLOCKADES.

IT required years of continuous improvements to convert railways into formidable competitors of water routes as cheap freight carriers of bulky products over long distances. At the outset they were scarcely expected to assume such a function. When they carried cheap and bulky articles at all it was usually only over comparatively short distances to an adjacent canal, river, or seaport. They were, however, considered very desirable for passenger traffic over the rapidly increasing interior routes, for the movement of freight which required rapid transit, and also for the continuation of all classes of freight movements during winter months when the rivers and canals were closed by ice, or when freshets damaged canals, and the temporary uselessness of water routes caused great scarcity of necessary articles. A vivid picture of the nature of some of the distress and inconvenience which railways were expected to diminish, and which they have practically abolished, is furnished in an article advocating the construction of the Erie Railroad, published in the Railroad Journal in January, 1832. It says: "It would prevent a recurrence of the state of things which now exists in the city of New York. There would not then be, as there now are, thousands of barrels of flour and other kinds of produce in proportion, frozen up in canal boats and in sloops on the Hudson; salt would not be now selling in Albany for $2.50 per bushel, and pork at $2 per hundred for want of salt to save it, whilst pork is worth from $5 to $7 in this city. Coal would not then sell here for $15 or $16 per ton; nor oak wood at $9, and hickory at $13 per cord, as has been the case for two or three weeks past, if railroads were in general use; but all kinds of business would move on regularly and be more equally divided throughout the year. Produce could come to market as well in January as in July; and the farmer would not be obliged, in order to get his crop to market in the fall, to neglect preparing for the next."

INCREASE OF THE VALUE OF REAL ESTATE.

The most important of all the results of the construction of railways cannot be stated with absolute accuracy, inasmuch as they consist of the increase of population at given points, advances in the price of property belonging to private owners, and development of new enterprises. Railways are only benefited incidentally by these advances through the increase in traffic they produce, while many individuals are enriched, and the market value of lands at terminal points and districts traversed is greatly enhanced. One of the leading arguments urged in favor of state aid to railways was to the effect that, however unprofitable such enterprises would be to their owners, they were certain to greatly increase the value of land, and that all the land-owners benefited should, therefore, be obliged to indirectly assume some of the risks of such undertakings. There is no doubt that the cash value of the property of the entire country has been advanced by railways to a sum that very greatly exceeds the cost of their construction, and it has unfortunately happened that such gains of land-owners and citizens have often occurred on lines that were very unprofitable to stockholders. In other words, an expenditure of a few billions of dollars for railways has benefited other persons, who have made no important investments in the securities of such enterprises, to the extent of many more billions of dollars.

A few of the early railway reports make interesting references to the increase in the value of the districts traversed, which are presumably typical of similar results in nearly all regions in which railways have been constructed. The report of the Georgia Central, dated November 1st, 1839, for instance, says: "In every case where a sale of real estate has taken place near the line, since the commencement of the work, the price has been much advanced, and in some cases to many times the amount that would have been demanded before the road was projected. In some instances the amount paid to the proprietor of the land for pine timber for the construction of the road has exceeded the price that the entire tract would have sold for three years ago. In the absence of more extensive experience as to the effect of the road on the value of lands in its vicinity, that of others similarly situated may with propriety be invoked to aid us in our conclusions." The president of the South Carolina Railroad Company, in his semi-annual report of July 10th, 1837, says: "To give some idea of the advantages derived by those not immediately connected with the company, by the passage of the road through so great an extent of pine barren, a moderate estimate has been made of the additional value of these lands since the road was located, and it has been found that the advance within a mile of the road, and beyond the influence of the towns at each end, not including anything within fifteen miles of either extremity, *has been equal to the cost of the original construction of the whole road.*" These statements were but forerunners of many much more remarkable advances in value of real estate in various portions of the Union which logically followed the construction of railways.

PASSENGER TRAFFIC.

The facilities furnished by railways were at first much more fully appreciated by travelers than by transporters. The novelty and unprecedented rapidity of journeys made in cars drawn by a locomotive, or even cars drawn by horses on a railway, presented so many elements of attractiveness that some persons traveled considerable distances by the old methods for the express purpose of securing an opportunity to ride a short distance on a railroad. All journeys that could be made by this new and popular mode were usually made in cars, even when they were over routes which necessitated frequent changes to stages, steamboats, or canal boats. Short railway links, which were steadily growing in length and importance formed parts of all the great thoroughfares.

The extent to which the old and new systems were intermingled, and the relative comfort and advantages of each, in 1839, is indicated by a statement compiled in January, 1840, by a foreign tourist who had made journeys aggregating 10,330 miles in length, during intervals between December 24th, 1838, and January 14th, 1840. He states that he made 175 separate journeys, and that he had not met with a single accident of the smallest kind. He compiled the following tabular statement:—

Manner of traveling (conveyance.)	Number of miles traveled.	Time occupied, exclusive of stoppages, hours.	Speed in miles per hour.	Charges for a single place (a person) whole distance.	Average charge per mile (cents.)
Railroads, steam power....	3,329	219	15	$177 00	5
Railroads, horse power....	215	36	6		
Steamboats, upon rivers...	2,220	$252\frac{1}{2}$	9	149 50	$4\frac{9}{10}$
Steamboats, lake and sea..	813	$79\frac{1}{2}$	10		
Stages and sleighs.........	2,949	602	$4\frac{9}{10}$	207 50	7
Canal boats...............	375	96	$3\frac{9}{10}$	17 20	$4\frac{6}{10}$
Sailing vessel............	136	54	$2\frac{1}{2}$	10 00	$7\frac{3}{10}$
Private conveyances......	293	42	7	36 80	$12\frac{1}{2}$
Total...............	10,330	1,381	av. $7\frac{1}{2}$	$598 00	$5\frac{6}{10}$

In commenting upon these journeys the author said: "The speed upon railroads is 50 per cent. greater than that of steamboats, to which I have, however, to remark, that the passage in steamboats upon rivers was nearly exclusively up stream. The speed upon common roads is less than one-third of that on railroads, the speed on canal boats only one-fourth. The average speed on the whole voyage, which is obtained by dividing the number of miles traveled by the time of motion, was $7\frac{1}{2}$ miles, or half the speed on railroads. The fare on steamboats and canal boats includes board, and is, therefore, the cheapest, the stage fares are 40 per cent. higher than the railroad charges, and the average rate per mile for the whole voyage was $5\frac{6}{10}$ cents."

The average speed of all American passenger trains, exclusive of stoppages, at the period mentioned, is probably stated with approximate accuracy in the record given above of 15 miles per hour. On some roads considerably higher speed was attained. A southern railway report speaks of a rate of 22 miles per hour having been maintained for a considerable period, but on account of the extra expenses necessitated, especially in repairs to locomotives, this rate was reduced to 17 miles per hour. Officers of various other roads respectively speak of passenger trains being run at the rate of 18, 20, and 25 miles per hour. David Matthews, superintendent of engines and machinery on the Utica and Schenectady, said in 1839: "We are five hours crossing the road, eighty miles, including fifteen stoppages."

Of speed on the Columbia and Philadelphia, for the year ending October 31st, 1837, its superintendent, Andrew Mehaffy, in his annual report to the state of Pennsylvania, said:—

"It is not denied that some discontent has existed at the low rate of speed on the road. But when it is known that the trip of 82 miles is now made in precisely the same length of time (viz., six and a half hours, including all stoppages consequent to taking in fuel and water) as when a high rate was permitted, the objection falls to the ground."

This rate of speed was a trifle more than 12.61 miles per hour. Mr. Mehaffy proceeds to say:—

"Within the last month the undersigned visited some of the most frequented roads in this part of the Union, for the purpose of contrasting their operations and regulations with the one under his charge, and the result, as far as speed is concerned, was decidedly such as to convince him of the propriety of the present management. Without wishing to disparage any, he is satisfied that, though more parade may be made by others, as great a degree of safety is not accomplished, nor as great an amount of work done."

On American, as well as the new foreign roads, the usual result of a decided increase in the number of persons who traveled over the various routes, after railway operations commenced, was noticed, but even with these gains the total number of passengers was comparatively small.

REGULATION OF FARES.

In contrast with the amount of business transacted on corresponding lines at the present day, the passenger receipts seem insignificant, but the development on some lines was sufficiently rapid to exceed the expectations of the projectors, and where the results were disappointing a remedy was sought in some localities in a reduction of fares, and in others in an increase of the authorized charges. The general drift with New England lines was in the first of these directions, and with some of the southern lines towards the second. In March, 1840, the legislature of Virginia permitted the Petersburg road to advance the price of passage to 8 cents per mile. Similar advances had been authorized in other Southern states, but the wisdom of enforcing them was in some cases questioned. For instance, a report of the Louisville, Cincinnati and Charleston (the temporary successor of the South Carolina), published in 1840, states that there was "a feeling adverse to the increased charge on passengers between Charleston and Hamburg, authorized by an act of the South Carolina legislature, and it is very questionable how far the higher rates now exacted have contributed to an augmentation of income. The reports show 4,000 passengers less this, as compared with the previous year, and the reports on the Georgia road exhibit nearly the same deficiency. . . . To a certain extent, reduction of the cost of freight and travel does stimulate to increase of receipts and of income. Thus it has been ascertained from calculation that a locomotive, with power to convey 200 passengers, can traverse a railroad at a cost of $1 per mile, or half a cent to each passenger, provided the whole number could always be obtained. Two hundred passengers, therefore, at $5, or even $3, to Hamburg, one-half or even one-third of the present charge, would be more remunerative to the share owners than the present daily average of some twenty-five or thirty passengers at $10 each." This fare of $10 was at about the rate of $7\frac{3}{10}$ cents per mile.

A report of the superintendent of the Philadelphia and Columbia Railroad for the year ending October 31st, 1837, states that at that time the charges for passengers, per mile, on the roads named below was as follows: Baltimore and Ohio, 3 cents; Baltimore and Washington, 6; Portsmouth and Roanoke, 6; Boston and Providence, 5; Boston and Lowell, 3½; Mohawk and Hudson, 5; Petersburg, 5.

THE HORSE-POWER RAILWAYS.

The first stage of railway development occurred on lines built with the expectation that they would be operated with horse power, as they were at the outset, leaving the question whether it should be supplanted by locomotives to be determined by the subsequent course of events. Before the money necessary to construct these railways could be raised, either by companies or states, it was requisite that the utility of such works should be demonstrated even if locomotives were never used upon them. There was, accordingly, a considerable amount of discussion of this subject, and many conflicting statements were made, relating to what horses could do or could not do, on railways, and the differences between the practical efficiency of horse power as applied to turnpikes, railways, and canals. The leading idea advanced by champions of the iron tracks hinged on amplications of the truism that they diminished friction to an extent that very greatly reduced the cost of movement. Perhaps none of these publications presented the issues involved in this controversy, in a brief space, and the

COMPARATIVE COST OF DIFFERENT METHODS,

as they were then understood, so clearly as the following extract from a report of the board of canal commissioners, of Pennsylvania, dated December 15th, 1831:—

"To counteract the wild speculation of visionary men, and to allay the honest fears and prejudices of many of our citizens, who have been induced to believe that railroads are better than canals, and consequently that for the last six years the efforts of our state to achieve a mighty improvement have been misdirected, the canal commissioners deem it to be their duty to advert to a few facts which will exhibit the comparative value of the two modes of improvement for the purpose of carrying heavy articles cheaply to market, in a distinct point of view.

Flour is now carried by the canal to Philadelphia from Lewistown, 211 miles, for 62½ cents, and from Harrisburg, 150 miles, for 40 cents a barrel; and gypsum is taken back for three dollars a ton to Harrisburg, and five dollars a ton to Lewistown, therefore the freight (exclusive of tolls) is downwards 14½ mills per ton per mile, and returning 7 mills per ton per mile; or on an average both ways one cent and three-fourths of a mill per ton per mile for carriage.

On nine miles of railroad at Mauch Chunk, and on ten miles of railroad between Tuscarora and Port Carbon, the carriage of coal costs four cents, and the toll on the latter road is a cent and a half per ton per mile.

The comparison will then stand thus:—

	Cents.	Cents.
On ten miles of railroad between Tuscarora and Port Carbon:—		
Freight, per ton	40	
Toll on coal, per ton	15	55
On ten miles of the Pennsylvania Canal:—		
Freight, per ton	10¾	
Toll on coal at one-half cent per ton per mile	5	15¾
		39¼

Being 39¼ cents difference in favor of the state canal for every ten miles of transportation.

The following table will exhibit the relative useful effects of horse power when employed on common roads, on turnpike roads, on railroads, and on canals:—

	Weight of freight transported. Tons.	No. of miles per day. Miles.
Four horses will draw, in addition to the weight of the carriage or boats containing the load, on a common road in a wagon	1	12
On a turnpike road, not exceeding five degrees of inclination, in a wagon	1½	18
On a railroad having a rise and fall of thirty feet (or one-third of a degree) to the mile, in eight cars	16	27
On the Pennsylvania Canal, in two boats	100	24

The introduction of locomotive engines and Winans cars upon railroads, where they can be used to advantage, will diminish the difference between canals and railroads in the expense of transportation. But the board believe that, notwithstanding all the improvements which have been made in railroads and locomotives, it will be found that canals are from two to two and a half times better than railroads for the purposes required of them by Pennsylvania."

CANALS *vs.* RAILROADS.

A favorite saying of the advocates of canals as internal improvements to be preferred to railways, was that a railroad occupied a middle ground between a good turnpike and a canal. Benjamin Wright, one of the earliest civil engineers in the country, said in 1831, after examining critically the canal and railroad of the Delaware and Hudson company, he "found that the expense on the railroads, not including any toll, would be about 3½ to 3½ cents per ton per mile; and on the canal, without toll, one cent to one cent and two mills per ton per mile." Josiah White, superintendent of the Mauch Chunk Railroad and Lehigh Canal, made a similar comparison in reference to operations on those works. The weak point in their argument was that the railways they referred to were among the earliest constructed in the country, and being intended solely for the transportation of coal they were not fair representatives of railway possibilities.

Other points made in favor of canals were that they required little intelligence on the part of those who operated them, that they would be open to any man who built a boat, and that those who used them could travel or stop, as they pleased, instead of being obliged to adopt rates of speed dictated by managers. One of Josiah White's general grounds of preference for canals, was novel yet, in some respects, prophetic. He said: "I think it rather fortunate for society that railroads are not of equal value to canals, for a railroad can be taken anywhere; and, consequently, no improvement would be safe on their line, for the moment the improvement succeeded, it would be rivaled, so as to destroy both, whereas we know the line and limits of our canals, by the supply of water, and graduation of the ground; so that all improvements thereon are safe against the undermining of rivals. I should consider that, if the railroads superseded canals, they would, for the above reasons, render the tenure or value of property as insecure as it would be without the protection of law."

One of the principal topics discussed by advocates of the opposing systems was the relative cost of construction—the champions of the railways contending that canals would, as a rule, always be the most expensive, and this allegation being denied by the advocates of canals. The instances were rare in which the cost of either of the proposed works did not greatly exceed estimates.

A large amount of data bearing on the relative utility of railways and canals, as freight carriers, is furnished by documents published by Congress, by order of the committee on internal improvements of the House of Representatives, in 1832. The leading advocates on one side were the Baltimore and Ohio Railroad, and on the other side the Chesapeake and Ohio Canal Company. Each of these corporations, through their engineers and officers, collected a large amount of the information then pertinent to a discussion of the comparative merits of canals and railroads. The president of the Baltimore and Ohio at that time was P. E. Thomas, and the chief engineer Jonathan Knight.

One of the arguments favorable to railways advanced in Mr. Knight's reply to the elaborate argument previously made by champions of the canal system was embraced in a reference to the fact that they had used comparatively old data, and that the railway cars, &c., had been materially improved since the tables referred to had been compiled. Special importance was attached to the reduction in friction effected by the Winans car. The significance claimed for these improvements was so great that Mr. Knight contended that, whereas an old table cited by the canal advocates had estimated that a power of 100 pounds would move at the rate of 3 miles per hour 38,542 pounds on a canal, and only 14,400 pounds on a level railway, with the new cars 40,000 pounds could be moved on a level railway. Tables which give varying velocities and effects were cited, and Mr. Knight said: "From an inspection of the *corrected* tables (that is, corrected so as to make due allowance for the benefits derived from an improvement in the cars, &c.), it will appear that when the velocity is 3 miles per hour it requires less power on the railway than on the canal to produce an equal effect. From a strict calculation, it will be found that the power required will be *equal* when the velocity is $2\frac{86}{100}$ miles per hour, or 4.2 feet per second."

A leading feature of his argument consisted of his advocacy of the theory that resistance on a level railway with proper cars is less than on water—while steam can be used more advantageously on land than on an artificial water channel, and thus the actual force employed can be subjected to a greater economy. Mr. Knight adds that "according to Tredgold, the maximum of useful effect of the labor of a horse will be obtained from a duration of six hours labor per day, at a velocity of three miles per hour, and the mean power of traction will be 125 pounds. The railway will, therefore, have the advantage of the canal, at a rate of speed best suited to the action of the horse. The effect of the railway is to that of the turnpike road as 22 to 4."

LOADS DRAWN BY HORSES ON EARLY RAILROADS.

Experience soon demonstrated that a strong horse could draw on a level railroad a great deal more than ten tons. One of the early instances recorded was a performance on the first portion built of the Baltimore and Ohio, in 1831. In describing it the Baltimore American said:—

"The experiment of the transportation of two hundred barrels of flour, with a single horse, was made on the railroad on Saturday with the most triumphant success. The flour was deposited in a train with cars, and made, together with the cars and the passengers who rode on them, an entire load of 30 tons, viz.:—

	Tons.
200 barrels of flour	20
8 cars	8
Passengers	2
	30

The train was drawn by one horse from Ellicott's Mills to the Relay House, 6½ miles, in 46 minutes. The horse was then changed and the train having again set out, reached the depot on Pratt street in 69 minutes. The road between the Relay House and the depot is a perfect level, except at three deep excavations, where an elevation of 17 to 20 feet per mile was opened for drainage."

COST OF EARLY RAILWAY FREIGHT MOVEMENTS.

TWO of the most important typical articles of through freight on a number of roads were cotton on southern lines, and flour on northern lines. It generally happened that the northern roads (except the anthracite railways) derived considerably more revenue from passengers than from freight, while on most of the southern roads more revenue was derived from freight than from passengers. The actual cost and standard of charges for all classes of freight movements were very much higher than at the present day, so much higher, indeed, that the quantity of products which would bear the inevitable cost of rail movements was comparatively limited.

Nearly all the freight moved consisted of articles produced on or near the route traversed, or merchandise forwarded from terminal towns or cities. The usual diversion of nearly all the trade previously conducted over considerable distances in heavy wagons occurred, but an exception was noted by the superintendent of the Philadelphia and Columbia, after it had been several years in operation, in the matter of whisky, as he stated that the tolls of the state and freight charges of car owners were too high to furnish sufficient inducements to distillers to transfer their business from the turnpike to the railroad. An early Camden and Amboy report refers to an incident of an opposite character as an illustration of the rapidity with which new forms of local traffic were developed. It consisted of an unexpected increase in the number of cars required for moving green corn from country districts to city markets.

INDUSTRIAL PRODUCTS IN 1840.

The nation had not yet been trained into reliance upon extensive sales of surplus products at distant points, except in connection with cotton, flour, tobacco, and a few other articles. Live stock was driven from place to place and not transported in cars. The total annual value of all the exports of domestic produce was usually a little more than one hundred millions of dollars, of which more than one-half was cotton, and generally tobacco ranked second on the list, and flour third. The census returns of 1840 reported the product of iron at 286,943 tons; anthracite coal, 863,489; bituminous coal, 27,603,191 bushels; wheat, 84,823,272 bushels; Indian corn, 377,531,875 bushels; tobacco, 219,163,319 pounds; cotton, 790,479,275 pounds; and the estimated value of all the manufactured goods produced in the country in that year was $370,451,754.

There was certainly not a very extensive basis for commerce of any kind, either foreign or domestic. It continued to be a national lamentation that the value of many products was consumed in vain efforts to get them to market. The proportion of articles moved from the point of production or its vicinity was smaller than at the present day, and the proportion of products moved over considerable distances which were transported over water routes was much larger than it has been during recent years.

In 1840 the value of foreign imports into and domestic exports from the principal commercial states was as follows:—

	Foreign imports.	Domestic exports.
Maine	$628,762	$1,009,910
Massachusetts	16,513,858	6,268,158
Rhode Island	274,534	203,006
Connecticut	277,072	518,210
New York	60,440,750	22,676,609
Pennsylvania	8,464,882	5,736,456
Maryland	4,910,746	5,495,020
Virginia	545,085	4,769,937
North Carolina	252,532	387,484
South Carolina	2,058,870	9,981,016
Georgia	491,428	6,862,959
Louisiana	10,673,190	32,998,059
Alabama	574,651	12,854,694
Florida	190,728	1,850,709
Unenumerated states	584,338	2,283,407
	$107,141,519	$113,895,634

Of all the domestic products exported in 1840, only a very small fraction were taken to the exporting points by rail. The great exporting centre of New Orleans had no interior rail freight connections, and New York, which ranked second as an exporting city, was substantially in the same position, the reliance for the extensive interior freight movements of these two cities being upon natural or artificial water channels, and mainly the Mississippi, the Hudson, and the New York canals.

The census report of 1840 stated the population of the United States to be 17,068,666, including 6,100 persons on board vessels of war in the naval service. The number of persons employed in various industries was as follows: Mining, 15,203; agriculture, 3,717,756; commerce, 117,575; manufactures and trades, 791,545;

navigation of the ocean, 56,025; navigation of canals, lakes, and rivers, 33,067; learned professions and engineers, 65,236. The number engaged in railway pursuits was not stated. It was perhaps considered too small to be worth mentioning.

FREIGHT CHARGES FOR EARLY MOVEMENTS BY RAIL.

A serious obstacle to the rapid increase of extensive rail movements of bulky freight, arose from the high standard of charges then prevailing, which was necessitated by the actual cost to railway companies of movements over imperfect lines, in small cars, drawn by locomotives of limited capacity.

A British writer states that the cost of transporting goods on the Liverpool and Manchester Railroad, during its early operations, was $2.79 per ton for 32 miles, or nearly nine cents per ton per mile. A similar standard prevailed on a number of American lines, and on some classes of articles these rates were exceeded.

The rates authorized by some of the early charters were ten cents per ton per mile on bulky articles, or ten cents per cubic foot on articles of measurement, for a distance of one hundred miles. The twelfth section of the charter of the Georgia Railroad and Banking Company was as follows: "That the said Georgia Railroad Company shall at all times have the exclusive right of transportation or conveyance of persons, merchandise, and produce over the railroad and railroads to be by them constructed while they see fit to exercise the exclusive right; provided that the charge of transportation or conveyance shall not exceed fifty cents per hundred pounds on heavy articles, and ten cents per cubic foot on articles of measurement, for every hundred miles, and five cents per mile for every passenger."

It was estimated during the first nine months of the operations of the Baltimore and Ohio that the cost of transportation on that road was six cents per ton per mile.

The Petersburg Railroad, one of the first lines constructed in Virginia, was prohibited by its charter from charging more than 12½ cents a mile on a ton of freight during the time the road was being constructed, and after its completion it was forbidden to charge more than $8 per ton on merchandise carried from Petersburg to Blakely, in North Carolina, a distance of 60 miles. This is at the rate of 13⅓ cents per ton per mile.

The cost of transportation to the operating company on the Mauch Chunk Railroad, 9 miles in length, of the Lehigh Coal and Navigation Company, which railroad was used mainly for the transportation of coal, all of which was carried down grade, for the year 1828, was reported as follows: Mules and horses cost 1⅓ cents per ton per mile; hands, 1⅓; repairing wagons, ⅔; oil, ⅕; total, $3\frac{53}{100}$ cents per ton a mile, full and one way, and the whole cost divided into the distance one way only.

The tolls charged by the state of Pennsylvania, on the Columbia and Philadelphia Railway, for the use of the road and locomotive power, which was, of course, exclusive of the charges imposed by owners of cars for freight movements, together with those charges, were described in an article written for the Journal of the Franklin Institute of May, 1840, by Mr. W. Hasell Wilson, civil engineer, to be as follows:—

"The rates of toll for the use of road vary from 6 mills to 4 cents per ton (of 2,000 lbs.) per mile. There are twelve different rates, the average of which would be 2 cents per ton per mile. The lowest rates are for coal, stone, iron ore, vegetables, lime, manure, and timber, and the highest are for dry goods, drugs, medicines, steel, and furs.

On the United States mail the toll is one mill per mile for every 10 pounds. On every passenger one cent per mile. In addition to these rates a toll is levied of one cent per mile on each burthen car, two cents per mile on each baggage car, and on every passenger car one cent per mile for each pair of wheels.

The motive power toll is, for each car having four wheels, one cent per mile; for each additional pair of wheels 5 mills; for each passenger one cent per mile, and for all other kinds of loading 12 mills per ton (of 2,000 lbs.). The owners of cars now charge $3.25 for every passenger and $7.50 for every ton of merchandise conveyed the whole length of the road, they paying all tolls, *which is at the rate of four cents per mile for passengers and 9.14 cents per mile for a ton of goods.* Taking the length of

8-wheel car at 30, and the load of a 4-wheel burthen car at 3 tons, we have the following results:—

Road toll on an 8-wheel car, 4 cents per mile.

Road toll on 30 passengers, 30 cents per mile.

Motive power toll on car, 2 cents per mile.

Motive power toll on 30 passengers, 30 cents per mile.

Total toll for 30 passengers, 66 cents per mile, or 2.2 cents per mile for each passenger, leaving 1.8 cents per mile to the owners of the car for every passenger.

Road toll on a 4-wheel burthen car, 1 cent per mile.

Road toll on three tons of dry goods, 12 cents per mile.

Motive power toll on car, 1 cent per mile.

Motive power toll on three tons of dry goods, 3.6 cents per mile.

Total toll on three tons of dry goods, 17.6 cents per mile, or 5.86 cents per mile per ton to the owner of the car."

The superintendent of motive power of the Columbia and Philadelphia Railroad, in a report for the year ending October 31st, 1837, said that the charges then imposed for carrying goods on the other railways named below were as follows:—

On the	For goods per ton per mile. Cents.
Baltimore and Ohio	4½
Baltimore and Washington	4
Winchester and Potomac	7
Portsmouth and Roanoke	8
Boston and Providence	10
Boston and Lowell	7
Mohawk and Hudson	8
Petersburg	10

He also gave in that report the following estimate of the cost to the road or the state of freight movements: "The annual cost to the state of transporting a ton of freight has been frequently inquired. From the closest calculation that has been made, it would seem that the expense of transporting one ton one mile in a train of twenty loaded cars, would be about eight mills, exclusive of the repairs, wear and tear of engines, and supervision. The state now charges twelve mills, allowing only four mills for the expenses and all other contingencies."

A NEW YORK ESTIMATE OF THE COST OF RAILWAY TRANSPORTATION.

In 1835 a report on the subject of the actual cost of transportation by rail was made to the New York legislature, which was criticised at a later period, on the ground that it unduly magnified the necessary expense of such movements, and that the information it furnished was based on operations on roads unfavorably located. Subsequent events have conclusively proved that the estimates were much higher than the facilities of improved roads would justify. The conclusions reached were of momentous importance, inasmuch as they formed a leading incentive to the enlargement of the New York canals, commenced in 1835 and completed in 1862, at an enormous expense, on the ground that genuinely cheap transportation could never be expected from railways.

DIFFERENCE OF RATES ON DIFFERENT LINES.

In early railroading, as at all later periods, there have been great variations in the freight charges imposed by different lines, many of which grew naturally out of differences in their cost, charter requirements, or other circumstances. The Baltimore and Ohio appears to have been one of the cheapest roads, as it is stated that at an early stage of its history its charter forbid freight charges exceeding four cents per ton per mile. Sundry controversial points were agitated, some of which arose from contests relating to the respective merits of railways and canals as freight carriers, and others from disputes in regard to the relative desirability of state and company management of railway operations. One of the results of state management of the main line of the Pennsylvania improvements, consisting chiefly of canals, but supplemented by two railroads, was alleged to be that the cost of transporting a barrel of flour from the Ohio river, or Pittsburgh, to Philadelphia in 1840 was $1.55. It had previously been reported, however, that in 1834 such movements were made for $1.12½ per barrel. The charge of $1.55 is at the rate of about four cents per ton per mile for the entire distance.

their bearing on the state *vs.* company management question, are stated in the following extract from an article published in the Railroad Journal, of January, 1840, which opposed the construction of the projected New York and Erie Railroad as a state work:—

"The state of Michigan opened 30 miles of the Central Railroad in January, 1838, and carries on the forwarding business, in all its branches, as well as the transportation of passengers, giving bills of lading for flour, butter, turkeys, live or dead hogs, &c., all under the direction of commissioners appointed annually. There are, of course, no 'tolls,' and the cost of transportation in 1838 was 37½ cents per barrel of flour carried 30 miles, or 12½ cents per ton per mile, while the Mohawk and Hudson Railroad, only 16 miles long, with three kinds and five changes of power, charged, and we believe still charges, 6¼ cents per barrel of flour, or very nearly 4 cents per ton per mile, one-third of the price charged by the state of Michigan. This same Mohawk and Hudson Railroad charges for light goods 6 cents per ton per mile, which it carries throughout the year at the rate of ten miles per hour for the very price charged on the Erie Canal for transportation during seven or eight months at the rate of two miles per hour. The rate for light goods from New York to Buffalo for 1839 was $1.20 per 100 pounds, and deducting 10 cents for the river, there remains $1.10 for 363 miles (on the canals), or $22 per ton, or 6 cents per ton per mile."

PROPHETIC VIEWS OF J. EDGAR THOMSON.

In connection with the controversies relating to the relative merits of canals and railroads as freight carriers, in 1840, one of the statements most frequently quoted by the advocates of the latter class of improvements, was an extract from a report of J. Edgar Thomson, chief engineer of the Georgia Railroad and Banking Company, whose lines had been constructed under his supervision, and which was beginning a prosperous career under his management. In view of the immense influence he subsequently exercised in verifying his statements they possess a significance which can scarcely be overrated, and they will forever stand out like beacon-lights of truth amid many shoals and quicksands of error. Mr. Thomson in this report, dated April 29th, 1840, when the road was well advanced towards completion, and its financial success seemed to be assured, said:—

"*I can now state with confidence, that whenever the transportation is of a mixed character, such as agricultural products, general merchandise, and passengers, sufficiently large to justify the construction of a good road, railways will be found to be not only the most expeditious, but the cheapest artificial medium of conveyance at present known.*"

RIVALRY BETWEEN LAND AND WATER ROUTES.

PAUCITY OF INTERSTATE-FREIGHT MOVEMENTS OVER ARTIFICIAL CHANNELS IN 1840, AND CAUSES WHICH CHECKED THEIR GROWTH.

THE condition of transportation development in the United States in 1840 is peculiarly instructive in connection with the projects then seriously discussed, and controversies that have agitated the country since that time, relating to the comparative cost on land and water routes of lengthy freight movements, and the sort of discrimination which fixes the charges for them at a much lower rate per ton per mile than the rate imposed on short freight movements.

In 1840 the power to make such distinctions on a scale of considerable national significance was vested chiefly in state governments. The only two lines over which they could be made effectually were the New York canals and the main line of the state of Pennsylvania, both of which were under the management of political officials, controlled, directly or indirectly, by legislatures; and every other railroad or canal then existing that was of sufficient length to engage extensively in through interstate-commerce movements had been assisted by state loans or state stock subscriptions to an extent that would justify absolute control of the general subject of the relations between through and local rates.

It was, therefore, the right and duty of the people and their direct agents to decide what those relations should be. If rates were adjusted on erroneous principles they suffered as taxpayers, because they were the chief financial supporters of all the railways and canals then existing, either by direct outlays, such as those made by New York and Pennsylvania for constructing their state works, or by indirect outlays, such as those made in various other states through subscriptions to stock, or loans of state bonds.

The practical decision generally reached on this question, in 1840 and for some years later, both by the state governments in imposing tolls, and most of the private companies in their combined charges for the equivalent of tolls and freight, was to impose a given rate per ton per mile, without regard to distance. This system had a thorough trial. The idea which found enthusiastic advocates at a later period, that no distinctions of the kind indicated should be made, or more especially none in favor of long movements, was extensively tested, and the results are known. Indeed a number of the prevailing practices and prejudices were in favor of discriminations in behalf of local trade and travel, and if decisions of the United States courts had not severely checked such tendencies it would be difficult to say how far they might have been carried.

A principal effect of this restrictive or discriminating policy was a failure of lengthy lines to serve a leading end of their existence. In other words, there were no extensive through or interstate-freight movements of bulky articles over artificial land or water routes in 1840. The most important channels for such movements were the New York canals, and official reports of their operations in 1840 show that in that year, out of a total movement of 1,417,046 tons, in both directions, the proportion received from other states was 214,456 tons, a little more than one-seventh of the entire movement, and the value of all such receipts, via Buffalo and Oswego, was only $7,877,358. The Pennsylvania main line had failed, most disastrously, to serve as a favorite channel for east-bound through movements of bulky western products. In 1835 the entire movement over the Portage Railroad was only about fifty thousand tons, and although this may have been subsequently increased, the east-bound through-freight movement over that road never reached considerable magnitude. This was partly because the composite character of the Pennsylvania main line, with its changes from canals to railroads, rendered it unable to compete in cost with the cheaper water channels of New York, and partly because the lakes furnished better feeders of traffic than the Ohio river; but there was a comparatively small amount of east-bound through movements on both these lines combined, and the principal advantage, in a national commercial point of view, resulting from the construction of the main line of the Pennsylvania state works, hinged on the fact that it enabled Philadelphia merchants to retain western trade which they would have lost without such aid. On account of the lower latitude in which the Pennsylvania canals were located, they could be opened earlier in the spring, and kept open later in the fall, than the New York canals, and they, therefore, furnished available channels of trade to Philadelphia and other portions of Pennsylvania during some weeks of every season at periods when New York did not possess similar advantages.

HOW THE GREAT WESTERN EMIGRATION MOVEMENT WAS MADE.

The following instructive and interesting account of the method of conducting the emigration movement to the Mississippi valley during the fourth decade is furnished in Flint's History of the Mississippi Valley, published in 1832:—

"On account of the universality and cheapness of steamboat and canal passage and transport, more than half the whole number of immigrants now arrive in the west by water. This remark applies to nine-tenths of those that come from Europe and the northern states. They thus escape much of the expense, slowness, inconvenience, and danger of the ancient, cumbrous, and tiresome journey in wagons. They no longer experience the former vexations of incessant altercations with landlords, mutual charges of dishonesty, discomfort from new modes of speech and reckoning money, from breaking down carriages, and wearing out horses. . . . Immigrants from Virginia, the two Carolinas, and Georgia still immigrate, after the ancient fashion, in the southern wagon. This is a vehicle almost unknown at the north, strong, comfortable, commodious, containing not only a movable kitchen, but provisions and beds. Drawn by four or six horses, it subserves all the various intentions of house, shelter, and transport, and is, in fact, the southern ship of the forests and prairies. The horses that convey the wagon are large and powerful animals, followed by servants, cattle, sheep, swine, dogs, the whole forming a primitive caravan, not unworthy of ancient days, and the plains of Mamre. The procession moves on with power in its dust, putting to shame and uncomfortable feelings of comparison the northern family with their slight wagon, jaded horses, and subdued though jealous countenances. Their vehicle stops; and they scan the staunch strong southern hulk, with its chimes of bells, its fat black drivers, and its long train of concomitants, until they have swept by.

Perhaps more than half the northern immigrants arrive at present by way of the New York canal and lake Erie. If their destination be the upper waters of the Wabash, they debark at Sandusky, and continue their route without approaching the Ohio. The greater number make their way from the lake to the Ohio, either by the Erie and Ohio or the Dayton canal. From all points, except those west of the Guyandot route and the national road, when they arrive at the Ohio, or its navigable waters, the greater number of the families 'take water.' Emigrants from Pennsylvania will henceforth reach the Ohio on the great Pennsylvania canal, and will 'take water' at Pittsburgh. If bound to Indiana, Illinois, or Missouri, they build or purchase a family boat. Many of these boats are comfortably fitted up, and are neither inconvenient nor unpleasant floating houses. Two or three families sometimes fit up a large boat in partnership, purchase an 'Ohio Pilot,' a book that professes to instruct them on the mysteries of navigating the Ohio; and if the Ohio be moderately high, and the weather pleasant, this voyage, unattended with either difficulty or danger, is ordinarily a trip of pleasure. A number of the wealthier emigrant families take passage in a steamboat."

FREIGHT TARIFFS PROPOSED BY ROBERT FULTON IN 1796.

Recurring to the main topic, of the deplorable lack of extensive through interstate-freight movements over all artificial channels, which was largely due to the fact that no material distinctions were made in toll or freight charges to favor or encourage lengthy movements, it is a notable circumstance that forty-four years before the period under discussion, long before a single mile of railway had been constructed, and when canal improvements were only beginning to attract serious consideration, Robert Fulton, the pioneer of successful steamboat operations, had clearly pointed out the necessity of such distinctions or discriminations.

In a letter he addressed to Thomas Mifflin, Governor of Pennsylvania, in 1796, advocating the construction of a canal between Pittsburgh and Philadelphia, he very forcibly depicted the necessity of lowering the charges per ton per mile on distant movements, and practically constructed for this projected line a freight tariff analogous to those in force during late years on many railway lines, but which few or none of the railway or canal lines existing in 1840 had the wisdom to adopt. In this remarkable letter Mr. Fulton, in describing the system that should be adopted in connection with the management of a canal extending from Philadelphia to Pittsburgh, said:—

"If I proceed with this progressive and creative system till a canal reached Fort Pitt, which, with some bends, I will call 360 miles, the country which the canal would accommodate would widen as it was more remote from Philadelphia. For instance, the man who lived 20 miles from Philadelphia might convey his goods 7 to the canal; the man at 40 miles distance might go 14 or 15 to the canal; at 60 miles, 20 to the canal, and so on, till at the extremity of 360 miles they would probably go 50 on each side to the canal; hence, if I average the whole, such a canal may be said to accommodate a country 360 miles long and 50 miles wide, on which the tonnage (or tolls) must now be regulated.

The man who resides 20 miles from Philadelphia, and 7 from the canal, should he convey a ton of goods by land, it would be worth at least fifteen shillings, as it would employ a man and two horses two days.

	s.	d.
The carriage to the canal, seven miles, in like proportion.....	5	4
Carriage on the canal.	4	0
	9	0

Thus the saving would be six shillings, and the tonnage (tolls) should increase to a certain sum on the first hundred miles of canal, keeping much within the limits of land carriage, then decrease as the boating increased, *in order to draw the trade of the back country into the canal.*

The expense of boating a ton 20 miles will be as follows: A man, boy, and horse will convey forty tons 20 miles for ten shillings, which is three pence per ton for 20 miles; but to allow for contingencies, say four pence per ton for boating 20 miles, the tonnage and boating on the 360 miles should then be regulated, perhaps, in the following order:—

Miles.	Tonnage (or tolls.) s.	d.	Boating. s.	d.	Amount. s.	d.
20......	4	0	0	4	4	4
40......	3	0	0	8	8	8
60......	12	0	1	0	13	0
80......	16	0	1	4	17	4
100*......	20	0	1	8	21	8
120......	19	8	2	0	21	8
140......	19	4	2	4	21	8
160......	19	0	2	8	21	8
180......	18	8	3	0	21	8
200......	18	4	3	4	21	8
220......	18	0	3	8	21	8
240......	17	8	4	0	21	8
260......	17	4	4	4	21	8
280......	17	0	4	8	21	8
300......	16	8	5	0	21	8
320......	16	4	5	4	21	8
340......	16	0	5	8	21	8
360†......	15	8	6	0	21	8

By this system the country, at the extremity of 360 miles, *would deliver* goods at Philadelphia *for twenty-one shillings and eight pence,* which is the same as paid at the distance of *one hundred miles,* to which the land carriage to the canal must be added. But as such a system would open a market to the remote country, every acre of ground within reach of the canal would be more valuable, and the carriage to the canal must be borne for some years. But as population increased, and the tonnage on the main line became productive, lateral branches would be cut from the canal, and thus further improve the country, the tonnage (or tolls) on such branches being proportioned, as before stated, *according to the distance from the city.*"

ELLET'S LAWS OF TRADE, SHOWING INJURIOUS EFFECTS OF OVERCHARGES AND UNDERCHARGES.

Other significant references to this subject were contained in a pamphlet devoted to it, entitled Laws of Trade, and a popular explanation of its contents, published by Charles Ellet, jr., in 1840. He was one of the most distinguished civil engineers of that era. The detailed explanations are so abstruse that it is almost impossible for unprofessional readers to fully comprehend them, or to recognize the force of the statements and arguments presented. One of the leading ideas advanced was that the tax-payers of the states which had made large investments in public works were then suffering pecuniarily, through avoidable diminutions of the revenue of those lines, and that the country at large was not benefited to the extent that was desirable and possible, on account of a failure to construct toll sheets in accordance with principles which, in some of their most vital features, substantially accord with those enunciated

* This being within the limits of land carriage, the tonnage (tolls) must now begin to decrease as the boating is increased.

† If the boats return without back carriage, the expense of boating, which on the 360 miles is six shillings, must be deducted from the tolls, and in proportion on the various parts of the canal.

Oliver Evans.

John Stevens.

George Stephenson.

Robert Fulton.

by Fulton in 1796. Mr. Ellet, in defining the most judicious charge on articles of heavy burden and small value, contended that the charge at each point should be "proportional to the ability of the article to sustain." This is only a paraphrase of the expression "what the traffic will bear," and Mr. Ellet approached still nearer to that famous expression by speaking of "the greatest tax for carriage which the commodity will bear." His pamphlet probably had considerable influence in directing the attention of railway managers to the importance of remodeling their tariffs in a way that would encourage and greatly increase lengthy through movements of cheap and bulky freight. He was, perhaps, the first person in the United States to lay down precise rules for the framing of toll sheets and freight charges on internal improvements, and some of his views might be advantageously adopted by those who have since carried the principle of cheapening lengthy movements to excessive and injurious limits.

To promote ease of explanation he adopted a distinction between freight and toll, which makes his remarks applicable to railway lines owned and operated by a given company, as well to state canals or railways, on which boats or cars were furnished by individuals. He said: "I shall designate by *freight* every expense actually incurred in the carriage of the community, and by *toll* the clear profit on its transportation; so that if the carrier, or transporting company, charge seven mills per mile for the carriage of one ton of any article, and the cost of repairs and superintendence of the line due to the passage of that ton is three mills per mile, I call the *freight* on the article one cent per ton per mile, and any charge, exceeding this three mills, which is assessed by the state or company, is what I denominate their toll."

He contended that this toll was improperly and unjustly levied on all American lines in 1840, and gave a number of illustrations of the losses of trade arising from the system of uniform charges per mile. The list of conclusions he reached embraced the following:—

"At the distance of one hundred miles from the mart, in the usual tariffs, a commodity is charged one dollar where it might bear a charge of three, and at three hundred miles it is charged three dollars where it could bear but one."

"The greater the distance the commodity is carried the less should be the toll levied upon it."

"However we depart from the charge which will yield the greatest revenue, there will be an increase or diminution of tonnage, and, of course, always a decrease of revenue. If the departure be an overcharge, the tonnage will be reduced a quantity directly proportional to the value of the overcharge, and the revenue proportional to the square of that departure."

"Where the object is to obtain the greatest possible revenue, it is a general law, susceptible of satisfactory proof, that the charge for toll should not exceed half that charge which would exclude the trade from the line."

"Where the most judicious charge is levied, the tonnage of the line will be one-half of the tonnage which would be obtained if no toll at all were exacted."

"Whatever unnecessary tax is levied on the trade is at least so much deducted from the revenue of the improvement."

In discussing the methods that should be pursued to derive the greatest profit from a given trade in articles of heavy burden and small value, he laid down the following rule:—

"To attain the greatest possible revenue from the trade, under an uniform charge, the profit received from each ton must be equal to the expense of its carriage."

This rule has been disregarded or violated in many modern railway operations, in the direction of undercharges, as persistently as the rules relating to overcharges were violated by managers of the early lines. An immense amount of freight has been carried on railways at rates that yielded no profit whatever over absolute cost of movement. Many causes contributed to such practices, some of the most prominent of which are active rivalries and aggressive railway wars. If Mr. Ellet's rule is even approximately correct, it may suggest advantageous changes in some freight tariffs wherever the desire to secure the greatest possible revenue, which is always strong, is not counteracted by antagonistic requirements.

THE CONFLICT BETWEEN RAIL AND WATER CARRIERS.

The systems pertaining to freight charges briefly discussed above, and plans for reducing the cost of railway freight movements, have an important bearing on the railway systems fairly commenced and projected in 1840. There were few problems then more earnestly discussed in engineering, commercial, and speculative circles, than the extent to which railways would probably be able to compete with canals and rivers as freight carriers. The groundwork of extensive practical tests of this question had already been established, by the rapidly advancing chain of railway connections running parallel with the Erie Canal; the commencement of the construction of the New York and Erie Railroad; the earnest advocacy of the completion of lines which would furnish railway connections between the city of New York and Albany, and thus parallel the North river; the near approach of the Reading railroad to the Schuylkill anthracite regions for the purpose of competing with the Schuylkill Canal as a coal carrier; the completion of the Philadelphia, Wilmington and Baltimore which furnished a railway link between Philadelphia and Baltimore and thus presented a choice of routes to shippers who had previously depended exclusively on the natural and artificial water routes connecting the two cities; the completion of a new railway and a new canal by the New Jersey companies connecting Philadelphia and New York; and various other enterprises.

Aside from these works, on which the merits and demerits of each of the respective land- and water-route methods have been tested in thousands of competitive struggles, extending through many years, and characterized by every variety of incident that the ingenuity, inventive genius, and adventurous spirit of a progressive people could suggest, a large proportion of all the railways projected in 1840 and built for some years after that period were vitally affected by the varying aspects of the irrepressible conflict between land and water routes as freight carriers.

The topography of the country created an immense basis of such struggles, in the oceanic boundary of the Atlantic seaboard on the east, the gulf of Mexico on the south, the lakes, St. Lawrence, and New York canals on the north, the Mississippi and its tributaries on the west, and the Appalachian chain which separated the seaboard states from those lying west of its mountain barriers.

Under old systems there were only two great natural outlets—the Mississippi and the St. Lawrence—for the bulk of the products of the interior portions of the United States lying west of the Appalachian chain. All modern American improvements, whether railways or canals, intended to affect the trade of this vast and productive region, have aimed at diverting portions of it to the districts or states which contained the principal part of such improvements.

The entire trade of the country of national significance had tended towards one of the four water systems which in 1840 were the practical boundaries of American development. The trade all went to and from either the Atlantic coast on the east, the gulf on the south, the lakes and the St. Lawrence on the north, or the Mississippi and its tributaries on the west. Therefore, every railway intended to serve anything more than local purposes aimed at a connection with one of these water channels, and the projectors of nearly all lines or combinations of lines which were expected to become parts of a through route of considerable consequence endeavored to establish a link between two or more of the four great water systems.

After such connections were formed, it still remained a question whether extensive links would prove profitable, and a leading factor in this problem was the relative cost of the through-rail movements contemplated and the rival movements that could be made over water routes, or combinations of rail and water routes. There has probably never been in the trade history of the world a contest so complicated as that which has arisen from the protracted struggle between these rival systems. It has not merely been a fight between an elephant and a whale, or between land routes ranged on one side and water routes on the other, but between the two rival routes of the lakes and the Mississippi, or the two whales; between various land routes leading eastward, which might be compared to gigantic elephants, and between combinations of elephants with little whales on one side and combinations of big whales and little elephants on the other. Two of the general tendencies that have prevailed amid many mutations are a steady cheapening of the cost of freight movements and an increase of the relative magnitude of the movement made eastward, parallel with the natural water route of the lakes and the St. Lawrence, as compared with the movement made southward, via the Mississippi.

If methods had not been devised for cheapening rail movements to a marvelous extent, their share in this great struggle would have been comparatively insignificant, but the fact that they were thus cheapened forms one of the most momentous changes in modern industrial history, and one of the cheapening agencies to which attention was first directed was the application of the Fulton and Ellet principles to extensive through-rail movements. Others were furnished by a long line of engineering and mechanical improvements.

PROGRESS OF STEAMBOAT DEVELOPMENT FROM 1830 TO 1841.

THE number and tonnage of steamers of all classes constructed in the United States from 1831 to 1840 inclusive, was as follows: Number, 1,015; tonnage, 175,697.73. The new construction more than doubled all previous labors of the kind. Up to 1840 there had been constructed 1,528 steamers, measuring 266,707.10 tons. An official return, somewhat incomplete, apportioned steam tonnage in existence in 1838, between the respective states, as follows:—

	No. of vessels.	Tonnage.
Maine	8	1,609
New Hampshire	1	215
Vermont	4	903
Massachusetts	12	1,443
Rhode Island	2	698
Connecticut	19	4,103
New York	140	29,708
New Jersey	21	3,757
Pennsylvania	134	18,243
Delaware	3	494
Maryland	19	6,800
District of Columbia	5	801
Virginia	16	1,970
North Carolina	11	2,014
South Carolina	22	4,794
Georgia	29	4,273
Florida	17	1,974
Alabama	18	2,703
Louisiana	30	4,986
Kentucky	41	8,356
Missouri	42	7,967
Ohio	79	15,396
Michigan	13	2,611
United States government	14	900
	700	126,718

Of these 700 steam vessels, from which returns were received in 1838, 351 were in use on the Atlantic and gulf of Mexico, 64 on the great northern lakes, and 285 on the waters of the Mississippi valley. The tonnage, so far as returned, was apportioned as follows: Atlantic and gulf of Mexico, 65,946; northern lakes, 17,287; Mississippi valley, 43,440. Up to and including 1838 there had been built in the United States 1,279 steamers, measuring 226,510 tons. A little more than half the steamers built up to that time were apparently then in existence. Their destruction was peculiarly rapid on the western rivers. The number of steam vessels constructed in various sections from 1831 to 1840, inclusive, was as follows: New England states, 25; northern lakes, 60; western rivers, 729; Middle and South Atlantic states, 195.

HIGH-PRESSURE STEAMBOATS.

The tonnage of the steamers reported in 1838 was almost equally divided between high-pressure and low-pressure engines, the former being 61,903 and the latter 64,770. But a wide difference in this respect existed in regard to the tonnage of the steamers of different localities. The Mississippi valley reported 43,440 of high pressure and none of low pressure; the northern lakes 7,986 of high pressure and 9,301 of low pressure; and the Atlantic and gulf of Mexico 10,477 of high pressure and 55,469 of low pressure. Analogous differences have been perpetuated, so that, generally speaking, Atlantic coast steamboats are usually propelled by low-pressure engines and Mississippi valley steamboats by high-pressure engines. The distinction is considered important by sensitive travelers, as they regard the latter as more dangerous than the former, and at various points they have probably shared the view expressed by Charles Dickens, in describing a high-pressure steamboat he saw about 1840, of which he said: "It always conveyed that kind of feeling to me which I should be likely to experience, I think, if I had lodgings on the first floor of a powder mill."

Some of the characteristics of steamboat travel on western waters in 1833 are described in the following extract from a letter written by the Hon. Levi Woodbury, from Shawneetown, on April 16th, 1833: "The top of our boat is covered with coops for hens and pigs, ducks and geese, part for the use of the boat, and part for the New Orleans market. To entertain us and raise our spirits to-day, the captain pointed out the place where the boat, in 1826, which had Lafayette on board, ran upon a snag and sunk, the old gentleman barely escaping with life, and losing most of his baggage. We heard yesterday of the loss of another boat, called the Reaper, in a similar way, and some hundreds of miles south of us. Ten or fifteen lives were lost, but most of those in the cabin were saved, as the cabin floated off, and did not sink."

Writing from below Memphis, on April 18th, 1833, he said:—

"Our boat, being on the high-pressure system, moves through the water with great speed, but with no ordinary noise. Every time it starts, and almost every half minute after, it issues groans like the lion or elephant, when irritated or vexed. Then occasionally the steam starts out of the funnel like a flash of lightning, and makes a hissing noise, that almost frightens one to leap overboard for safety." In reference to the associations on board, he makes several references to active gambling operations, and gives the following graphic picture of one of the methods adopted to while away the time: "One man on board has a large collection of game cocks he is taking to New Orleans, and which he expects to sell at from five to twenty dollars each. Another has a great number of common fowls for market at New Orleans. Yesterday they selected a rooster from each, and after a long battle on deck, the common dunghill cock rather worsted the game cock. They then betted high, sawed off their spurs, put on gaffs, &c., and very soon both were run through the neck; but the game cock was first able to stand again, and, therefore, won."

In "A View of the Valley of the Mississippi," published in 1834, the author, in his description of the steamboats of that period, says: "Although the steamboats of the west are generally designed for carrying freight as well as passengers, yet it is astonishing what a number of persons one of them can carry. Even a boat of 100 tons often carries fifty cabin passengers; as many more, or perhaps twice as many, on deck; and withal 75 or 80 tons of freight! And a boat of 500 tons, such as the Uncle Sam, or the Red Rover, or Belfast, has often carried 100 passengers in their cabin, 500 on deck, and 400 tons of freight, and withal marched up the mighty Mississippi at the rate of six or eight miles an hour. Immense numbers of passengers are carried from one part of the valley to another by these boats. Those boats which come up from New Orleans bring, besides merchants and other inhabitants or strangers, who occupy the cabin, hundreds of Germans, Irish, and other foreign emigrants who land at that port, and are seeking a home in the interior of the valley of the Mississippi. On the other hand, those which descend from Pittsburgh carry hundreds of travelers and emigrants from the east, as well as from foreign lands."

Some of the early western river boats made remarkably good time. It is reported that on the 5th of June, 1836, the steamboat Ben Franklin made the run from Cincinnati to Louisville in 7 hours and 55 minutes.

Of a steamboat in which Charles Dickens journeyed down the Ohio from Cincinnati, in 1840, he said:—

"We had, for ourselves, a tiny state-room, with two berths in it, opening out of the ladies' cabin. There was, undoubtedly, something satisfactory in this 'location' inasmuch as it was in the stern, and we had been a great many times very gravely recommended to keep as far aft as possible, 'because the steamboats generally blew up forward.' Nor was this an unnecessary caution, as the occurrence and circumstances of more than one such fatality during our stay sufficiently testified.

If the native packets I have already described be unlike anything we are in the habit of seeing on water, these western vessels are still more foreign to all ideas we are accustomed to entertain of boats. I hardly know what to liken them to, or how to describe them. In the first place, they have no mast, cordage, tackle, rigging, or other such boat-like gear; nor have they anything in their shape at all calculated to remind one of a boat's head, stern, sides, or keel. Except that they are in the water, and display a couple of paddle-boxes, they might be intended, for anything that appears to the contrary, to perform some unknown service, high and dry, upon a mountain top. There is no visible deck, even; nothing but a long, black, ugly roof, covered over with burnt-out feathery sparks, above which tower two iron chimneys and a hoarse escape-valve, and a glass steerage house. Then, in order, as the eye descends towards the water, are the sides and doors, and windows of the state-rooms, jumbled as oddly together as though they formed a small street, built by the varying tastes of a dozen men. The whole is supported on beams and pillars resting on a dirty barge, but a few inches above the water's edge, and in the narrow space between this upper structure and this barge's deck are the furnace fires and machinery, open at the sides to every wind that blows, and every storm of rain it drives along its path."

Of a journey on the Mississippi, during the era when it was bountifully supplied with snags, he said: "If coming up this river, slowly making head against the stream, be an irksome journey, the shooting down it with the turbid current is almost worse; for then the boat, proceeding at the rate of twelve or fifteen miles an hour, has to force its passage through a labyrinth of floating logs, which, in the dark, it is often impossible to see beforehand or avoid. All that night the bell was never silent for five minutes at a time; and after every ring the vessel reeled again, sometimes beneath a single blow, sometimes beneath a dozen dealt in quick succession, the lightest of which seemed more than enough to beat in her frail keel, as though it had been pie-crust."

ON THE ATLANTIC COAST

the original type of low-pressure engines has generally been adhered to, and most of the important eastern steamboats or steamers traverse tide-waters free from liability to a number of the peculiar perils and dangers of western rivers. They are radically different boats, in several respects; having less to fear from snags and low water, and when they venture out into the ocean or its vicinity, more to apprehend from high waves and storms. The speed, size, and strength of some of the Hudson river, Long Island sound, and other eastern boats were materially increased at a comparatively early period. The Albany, built in New York, in 1832, was 272 feet long, 26½ feet beam, and 8½ feet deep in the hold, registering 588 tons. Boats built to traverse Long Island sound were broader and deeper than those of the river. One built in New York in 1836, the Massachusetts, had a length of 202 feet, a breadth of 29 feet, a depth of hold of 12 feet, and a tonnage of 676. Steamboats for trips along the coast outside of the rivers and sounds were built as early as 1832, and before many years had elapsed steam vessels were plying between all the principal ports on the Atlantic and gulf coasts.

RAILROAD CONSTRUCTION FROM 1840 TO 1850.

THE number of miles of railroad built in the United States from 1840 to 1850 was 5,045.77, the new mileage of each year being as follows: 1840, 490.51; 1841, 605.88; 1842, 504.68; 1843, 287.81; 1844, 179.96; 1845, 276.91; 1846, 332.77; 1847, 262.51; 1848, 1,056.46; 1849, 1,048.28.

The total number of miles built in each of the geographical groups was as follows: I. Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut, 1,899.10. II. New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, and District of Columbia, 1,805.57. III. Virginia, West Virginia, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, and South Carolina, 1,218.37. IV. Illinois, Iowa, Wisconsin, Missouri, and Minnesota, 97. V. Louisiana, Arkansas, and Indian Territory, 25.73.

The names of the lines by or to which these additions of mileage were made, and the years in which they were completed, are shown in the following table:—

Corporation.	1840.	1841.	1842.	1843.	1844.	1845.	1846.	1847.	1848.	1849.	Decade.
GROUP I.—*Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut*	156.66	99.97	180.16	20.93	42.16	88.46	123.28	162.43	441.29	583.76	1,899.10
Atlantic and St. Lawrence	....	....	....	....	....	....	....	....	15.25	21.00	36.25
Berkshire	....	....	22.00	....	....	....	....	....	....	....	22.00
Boston and Albany	....	87.97	15.50	....	....	....	4.80	....	13.55	....	121.82
Boston, Clinton, Fitchburg and New Bedford	20.13	....	....	....	....	....	....	0.96	....	15.17	36.26
Boston, Concord and Montreal	....	....	....	....	....	....	....	....	28.82	8.63	37.45
Boston and Lowell	....	....	....	....	1.92	6.56	....	13.59	....	....	22.07
Boston and Maine	12.00	12.00	10.50	10.25	....	....	16.00	2.00	....	3.75	66.50
Boston and Providence	....	....	....	....	4.11	....	....	....	5.37	....	9.48
Central Vermont	....	....	....	....	....	....	....	....	55.27	33.60	88.87
Cheshire	....	....	....	....	....	....	....	21.39	9.71	22.52	53.62
Concord	....	....	34.53	....	....	....	....	....	....	....	34.53
Concord and Claremont	....	....	....	....	....	....	....	....	....	33.19	33.19
Connecticut and Passumpsic Rivers	....	....	....	....	....	3 22	34.86	....	13.64	....	51.72
Dorchester and Milton	....	....	....	....	....	....	....	3.30	....	....	3.30
Dover and Winnipiseogee	....	....	....	....	....	....	....	....	....	18 00	18.00
Eastern (of Massachusetts)	13.70	....	....	....	....	....	....	12.94	3.79	....	30.43
Eastern (of New Hampshire)	16.08	....	....	....	....	....	....	....	....	....	16.08
Fitchburg	....	....	....	10.68	10.13	29.52	....	11.55	....	3.46	65.34
Housatonic	35.00	....	39.00	....	....	....	....	....	....	....	74.00
Maine Central	....	....	....	....	....	....	....	....	6.40	71.00	77.40
Manchester and Lawrence	....	....	....	....	....	....	....	....	23.45	....	23.45
Naugatuck	....	....	....	....	....	....	....	....	....	56 55	56.55
New Haven and Northampton	....	....	....	....	....	....	....	....	27.40	....	27.40
New London Northern	....	....	....	....	....	....	....	....	....	21.00	21.00
New York and New England	....	....	....	....	....	....	....	....	....	57.16	57.16

Corporation.	1840.	1841.	1842.	1843.	1844.	1845.	1846.	1847.	1848.	1849.	Decade.
New York, New Haven and Hartford					26.00				61.20		87.20
New York, Boston and Providence									4.38		4.38
Northern (of New Hampshire)							18.56	46 21	17.26		82.03
Norwich and Worcester	59.75										59.75
Old Colony						49.16	30.41	7.08	39.30		125.95
Pittsfield and North Adams							18.65				18.65
Portland, Saco and Portsmouth			50.76								50.76
Portsmouth, Great Falls and Conway										20.12	20.12
Providence and Worcester								43.41			43.41
Rutland										119.70	119.70
Stockbridge and Pittsfield										22.00	22.00
Stony Brook									13.16		13.16
Sullivan County									24.72		24.72
Vermont and Canada										41.70	41.70
Vermont and Massachusetts									32.53	15.21	47.74
Whitneyville and Machiasport			7.87								7.87
Worcester and Nashua									46.09		46.09
GROUP II.—*New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, District of Columbia*	83.87	244.02	204.79	47.88	108.30	179.45	51.49	75.08	499.67	311.02	1,805.57
Annapolis and Elkridge	20.50										20.50
Baltimore and Ohio		41.59	55.50								97.00
Chemung										17.40	17.40
Cincinnati, Sandusky and Cleveland									153.75	15.51	169.26
Columbus and Xenia										54.74	54.74
Cumberland and Pennsylvania						9.46					9.46
Detroit, Grand Haven and Milwaukee		5.50		7.25							12.75
Jeffersonville, Madison and Indianapolis		6.00				27.00		31.00	27.00		91.00
Lake Shore and Michigan Southern	11.37			33 25							44.62
Lehigh Coal and Navigation Company	17.50										17.50
Little Miami		14.00				49.98	20.00				83.98
Little Schuylkill Navigation Railroad and Coal Co.										3.00	3.00
Long Island		16.75			52.50						69.25
Lykens Valley Railroad and Coal Company									14.55		14.55
Michigan Central		38.16			32.34	12.46	22.90		47.89	26.95	180.70
Mine Hill and Schuylkill Haven								7.00			7.00
Morris and Essex									11.88		11.88
Mount Carbon and Port Carbon					2.50						2.50
New York Central and Hudson River		76.54	99.82			21.99				73.75	272.10
New York and Harlem			5.50		11.50			24.50	27.96		69 46
New York, Lake Erie and Western		45.57		7 38			8.59	12.58	126.61	58.67	259.40
Oswego and Syracuse									34.98		34.98
Paterson and Ramapo									15.02		15.02
Pennsylvania										61.00	61.00
Philadelphia and Reading	8.50		40.40								48.90
Renssalaer and Saratoga									39 24		39.24
Sandusky, Mansfield and Newark						62.25					62.25
Schuylkill Valley Navigation and Railroad Company			3.57								3.57
Terre Haute and South-eastern	26.00										26.00
Troy and Greenbush Railroad Association						5.77					5.77
Union (of New York)									0.79		0.79
GROUP III.—*Virginia, West Virginia, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, South Carolina*	249.98	261.89	40.00	219.00	29.50	9.00	158.00	25.00	105.50	120.50	1.218.37
Brighthope				18.00							18.00
Carolina Central				192.10			103.00				295.00
Chicago, St. Louis and New Orleans	13.73										13.73
Georgia Railroad and Banking Company	22.75	20.00	40.00			9.00	34.00	25.00			150.75
Greenville and Columbia									47.50		47.50
Jacksonville, Pensacola and Mobile							21 00				21.00
Louisville, Cincinnati and Lexington										28.50	28.50
North Carolina										92.00	92.00
Raleigh and Gaston	50.00	47.00									97.00
Rome									20.00		20.00
South Carolina		68.00							38.00		106.00
Vicksburg and Meridian		45.00									45.00
Western (of Alabama)		81.89			29.50						111.39
Wilmington and Weldon	163.50										163.50
GROUP IV.—*Illinois, Iowa, Wisconsin, Missouri, Minnesota.*			54.00						10 00	33.00	97.00
Chicago and North-western									10 00	33.00	43.00
Wabash, Chester and Western			54.00								54.00
GROUP V.—*Louisiana, Arkansas, Indian Territory*			25.73								25.73
West Feliciana			25.73								25.73

MILEAGE AND COST OF CONSTRUCTION IN EACH STATE AT END OF 1850.

In addition to the construction mentioned in the above table, there were considerable additions made to mileage in 1850, which increased the entire mileage to such an extent that the census report of 1860 gives the number of miles of railroad in operation in each of the states at the end of 1850, and the cost of construction, &c., as follows:—

States.	Mileage in operation at end of 1850.	Cost of construction, &c.
Maine	245.59	$6,999,894
New Hampshire	465.32	14,774,133
Vermont	279.57	10,800,901
Massachusetts	1,035.74	47,886,905
Rhode Island	68.00	2,802,594
Connecticut	413.26	13,989,774
New England states	2,507.48	$97,254,201

States.	Mileage in operation at end of 1850.	Cost of construction, &c.
New York	1,403.10	$65,456,123
New Jersey	205 93	9,348,495
Pennsylvania	822.34	41,683,054
Delaware	39.19	2,281,690
Maryland	253.40	11,580,808
Middle Atlantic states	2,723.96	$130,350,170
Virginia	515.15	$12,585,312
North Carolina	248.50	3,281,623
South Carolina	289.00	7,525,981
Georgia	643.72	13,272,540
Florida	21.00	210,000
Southern Atlantic states	1,717.37	$36.875,456
Alabama	132.50	$t,946,209
Mississippi	75.00	2,020,000
Louisiana	79.50	1,320,000
Gulf states	287.00	$5,286,209
Kentucky	78.21	$1,830,541
Ohio	575.27	10,684,400
Indiana	228.00	3,380,533
Michigan	342.09	8,945,749
Illinois	110.50	1,440,507
Wisconsin	20.00	612.382
Interior states	1,353.98	$26,894,112
Recapitulation:—		
New England states	2,507.48	$97,254,202
Middle Atlantic states	2,723.96	130,350,170
Southern Atlantic states	1,717.37	36,875,456
Gulf states	287.00	5,286,209
Interior states	1,353.98	26,894,112
Total United States	8,589.79	$296,660,148

PACIFIC RAILROAD PROJECTS.

The historic events which happened during the fifth decade include the annexation of Texas, the Mexican war, the acquisition of California, and the definite settlement of the northwestern boundary line, which separates British Columbia from Washington Territory. The large extension of the "area of freedom" on the Pacific coast, and the great rush of emigration to that region after the discovery of gold placers and mines, by water and overland routes, expanded national ideas in regard to probable transportation wants to such an extent that before the close of the decade the agitation of projects for constructing a railway to the Pacific coast was commenced, and Congress had made an appropriation of $50,000 to defray the expenses of surveys of routes, from the valley of the Mississippi to the Pacific ocean, of roads and railways. Progressive men no longer asked whether the Alleghenies could be crossed by the locomotive, for that problem was being rapidly solved, but whether practical rail routes could ever be found which would lead through the Rocky mountains and other towering ranges which separated the Pacific from the central portions of the country.

RAILWAY CONNECTIONS BETWEEN THE ATLANTIC COAST AND THE MISSISSIPPI VALLEY.

The most remarkable and permanently useful development of the fifth decade, and early years of the sixth decade, resulted from the persistency with which projects for securing railway connections between leading Atlantic seaboard cities and water systems west of the Appalachian chain were being pushed forward. This was the great work of the era. It was first accomplished at the extreme points, in or about 1850, Boston, on the north, securing continuous rail connection with the lakes through the Massachusetts lines, subsequently known as the Boston and Albany, and the links of short railways running parallel with the Erie Canal, which were formally united in 1853 under the title of the New York Central; and Georgia, on the south, through the Western and Atlantic, built by that state, and extending from Atlanta to Chattanooga, securing a rail connection between that city, which was reached by the head waters of the Tennessee, one of the most important of the tributaries of the Mississippi, and roads leading from Atlanta to Georgia seaports. While these achievements were progressing the New York and Erie was rapidly wending its way westward to furnish a rail connection between the city of New York and lake Erie, at Dunkirk; the Pennsylvania Railroad was crossing the Alleghenies, with Pittsburgh, the head waters of the Ohio, as its objective point, and the Baltimore and Ohio was advancing toward Wheeling, a point on the Ohio river, located a short distance below Pittsburgh. The main lines of these three railways were each completed at an early period of the sixth decade, the New York and Erie being opened to Dunkirk on April 22d, 1851; the Western division of the Pennsylvania, which extended from the western end of the Portage Railroad, being opened on September 10th, 1852, and the Baltimore and Ohio being opened to Wheeling on January 1st, 1853. In addition to these movements, the Hudson River Railroad was opened between New York city and East Albany on October 3d, 1851, thus furnishing a rail connection between New York city and the New York Central.

Thus four great east and west railway trunk lines, connecting Boston, New York, Philadelphia, and Baltimore, were completed at an early period of the sixth decade. On the south, Georgia had secured a similar connection, and South Carolina, although baffled in her first plan for reaching Cincinnati and Louisville, was endeavoring to accomplish the same end by other methods for the benefit of Charleston. At intervening points strenuous efforts were made to pierce the Appalachian chain by routes intended to promote the commercial interests of Norfolk and other cities of Virginia. Mobile was also preparing to extend a railway northward towards the mouth of the Ohio, through the Mobile and Ohio. In the extreme north, Boston was not only promoting the construction of rival routes through Vermont, but the Atlantic and St. Lawrence, leading westward from Portland, through Maine, New Hampshire, and Vermont, was opened from Portland to Island Point, Vermont, on January 20th, 1853, and in August of that year it was leased for 999 years to the Grand Trunk, of Canada, and thus made the eastern link of a fifth trunk-railway connection between Western and Northern Atlantic states.

VARIOUS FIELDS OF RAILWAY PROGRESS.

In addition to the construction of a considerable number of useful local lines, the construction of many of the links subsequently used in some of the numerous routes that connect the seaboard with the Mississippi valley, and the commencement or extension of lines intended to improve the railway approaches to the anthracite coal regions, two other movements of general significance were progressing, one of which was the improvement of the rail connections on the great north and south through-route adjacent to the Atlantic coast, and the other the commencement of the construction of railways in various portions of the Mississippi valley, which were intended to assist its inhabitants in their strenuous efforts to reach desirable markets for their surplus products, either by extensions to lakes, rivers, or canals, or to some of the railway lines then rapidly advancing westward.

The direction and some of the characteristics of railway progress have at nearly all times, and especially during the fifth decade, been affected by the complex political system of the United States, with its division of authority between the central or Federal government and the various commonwealths. As all the early charters were granted by some one or more of the state legislatures, it was natural that the effect of any particular line proposed on the prosperity of the state it was intended to traverse should be seriously considered in connection with the question whether the charter applied for should be granted or refused. The transportation systems of all the original colonies had been based on the idea of promoting, as far as possible, trade from their interior counties to their seaboard cities, and discouraging movements from the interior to adjacent states, except so far as they were imperatively demanded by local interests. This style of procedure was adhered to while the basis of the existing railway system was being established with a tenacity which has left a deep impress on its fundamental features, and it was only through many struggles and gradual changes that serious innovations finally occurred. It necessarily happened that a leading object of the through railways authorized in each Atlantic seaboard state was to increase the commerce of its seaboard city, and even short incursions of lines intended to promote the prosperity of rival cities, such as the crossing of north-western Pennsylvania by the Lake Shore, of north-eastern Pennsylvania by the Erie, or of south-western Pennsylvania by the Baltimore and Ohio, usually encountered bitter opposition. The process of breaking down state barriers made comparatively little headway during the fifth decade, and most of the commonwealths acted on the charters proposed very much as if they were entirely independent of each other in the fullest sense, and as if questions relating to the grant of the right of way to railways intended to facilitate intercourse with the leading cities of other states should be decided in the spirit that would presumably animate the legislative bodies of distinct kingdoms.

IN THE NEW ENGLAND STATES,

more miles were constructed during the fifth decade than in any other section. This is the only decade in which such a geographical distribution of new mileage has occurred. In the previous decade the New England states built only a little more than one-fourth as many miles as the states in group II, and in the decade extending from 1850 to 1859, inclusive, they constructed less than one-sixth as many miles as the states in group II, only a little more than one-fourth as many miles as the states in group III, and only a little more than one-third as many miles as the states in group IV. A considerable number of the citizens of New England, however, have been exceptionally active in promoting the construction of railways in other states and territories ever since their own early lines were completed.

Among the reasons for the exceptional activity in New England during the fourth decade, the most prominent are probably to be found in her superior financial condition and the good fortune which had attended the important railway enterprises commenced within her boundaries during the third decade. The panic of 1837 and the collapse of state credit about 1842, put back railway progress at least ten years in many sections of the country. The western, south-western, and some of the Southern and Middle states (especially Pennsylvania) suffered very severely in credit and capacity to prosecute great undertakings. New England, on the contrary, recuperated very rapidly. Her own citizens had furnished the principal part of the capital used in her early railways. They owned these lines, and on account of this ownership had exercised over them a jealous supervision, and ensured profitable results whenever they were possible. Aid granted by states had represented comparatively small sums; no state bonds had been dishonored by a failure to provide promptly for interest obligations; and the fact that no internal improvements of considerable magnitude had been undertaken by these states left the field clear for the corporate efforts of comparatively small companies, a large proportion of which have since enjoyed a career of almost uninterrupted prosperity. New England then, as at the present day, contained a remarkably large number of independent companies, each operating a relatively small amount of mileage. Of seventy New England companies reported in 1850 only three had lines more than one hundred miles in length. They were the Rutland and Burlington, 119.54 miles, and Vermont Central (with branch), 120 miles, of Vermont; and the Western, of Massachusetts, 117.81 miles. The average length of each of the New England roads, in 1850, was less than 36 miles, and the average cost, per mile, was about $38,800.

The exceptionally long lines represented, in the case of the Western, the efforts subsequently combined under the corporate name of the Boston and Albany to extend a railway from the first to the second of those cities, for the purpose of making a combination with the chain of railways from Albany to the lakes, now part of the New York Central system. The operations of the Western were exceptionally successful. The road paid good dividends, and at the same time rendered great service to Boston and Massachusetts by diminishing the cost of transportation on staple-food products forwarded from the west, and in developing local industries. The entire line formed by the junction of the two systems mentioned above in Massachusetts and New York was one of the first, if not the first, to form a direct through-rail connection between the lakes or water systems west of the Appalachian chain and an Atlantic seaboard city, and it was expected that this achievement would render immense service to Boston, in the way of advancing her relative rank as an American commercial emporium. New York, however, did much to thwart this tendency, by greatly restricting the utility of the railways which paralleled the Erie Canal as freight carriers, inasmuch as all freight carried over their lines was obliged to pay the tolls charged on the canals until an act repealing this tax was passed in December, 1851; by reducing the tolls on the Erie Canal; and by hastening the completion of the Erie Railroad in southern New York, which was built with the expectation that it would become a successful rival of the more northern trunk line, and thus render greater service to the city of New York, in a commercial sense, than Boston could possibly derive from the Western and its advantageous connections.

Fully conscious of this danger, Boston enterprise and Boston capital looked in another direction for the accomplishment of the objects that were not likely to be fully served by the Western Railroad, and, therefore, aided the construction of the lengthy lines in Vermont for the purpose of making a connection through them with the water systems leading from the west. Several Massachusetts lines were used as links in this system, one of the most important being the Boston and Lowell. Before the end of the fourth decade Boston had three railways radiating in three directions, which were the pioneers of the Massachusetts system. At the end of the fifth decade she had seven lines, extending to or towards the adjacent states. Other New England railways which had more than useful local significance, aimed at establishing connections between Boston and Maine on the north or north-east, and between Boston and New York on the south-west, and the Atlantic and St. Lawrence, of Maine, which by extensions through adjacent states became an eastern link of the Grand Trunk (of Canada) leading to Portland.

THE RAILROADS OF NEW YORK IN 1850

presented a singular contrast with those of New England, in the matter of diversity of ownership. Of the entire mileage of 1,403.10, which had cost $65,456,123, or an average of about $46,650 per mile, more than half the mileage and nearly two-thirds the cost were represented by two lines. What is now the New York Central (with branches) was 447 miles in length and had cost $20,023,863. The New York and Erie, then not completed (with branch), was 337 miles in length and had cost $20,066,208. The New York Central of that day did not include the Hudson River or the New York and Harlem (with branches); which were subsequently united with the New York Central system. The Hudson River in 1850 had a mileage of 74.71, which had cost $6,666,681; and the New York and Harlem had a mileage of 80.17, which had cost $4,666,372. These lines were subsequently embraced within the New York Central, and if the cost be added to the New York Central figures given above, and the cost of the New York and Erie, the aggregate will be $51,423,124, leaving a total of only $14,032,999 for all the other railways in operation in the state of New York in 1850. Several of these lines, however, were built for the purpose of diverting through western trade from various other points on the lakes than Buffalo, and New York was in a fair way (as subsequent developments have shown) to be as successful in maintaining through western trade connections during a railway era, as she had been during an era of canals.

One of the most notable features of the railway development of the fifth decade is the extraordinary extent to which construction progressed, during that period, on the various lines subsequently designated as the Vanderbilt system, not only in New York, but in other states.

IN NEW JERSEY,

at the end of 1850, the 205.93 miles in operation, which had cost $9,348,495, or an average of about $45,370 per mile, consisted, in addition to the Camden and Amboy (with branches) of 92.37 miles, and the New Jersey, with a mileage of 33.80, which had been operated very successfully, in a financial sense, of 9.50 miles of the Central of New Jersey, then a very promising project; links or connections of the New York and Erie in the northern part of the state, and the Morris and Essex, with a mileage of 34.02. The Central of New Jersey and Morris and

Essex were presumably located with the view of finally making such connections as were subsequently formed with lines leading to the anthracite coal regions of Pennsylvania.

PENNSYLVANIA,

at the end of 1850, had made less relative progress in railway development during the preceding ten years than any other state, if due allowance is made for the fact that her mileage had exceeded that of any other commonwealth in 1839. In only two directions was there any movement of considerable significance whatever. They were the Philadelphia and Reading, which had completed its main line to the Schuylkill anthracite coal regions, and had a reported mileage of 95, and the Pennsylvania Railroad, then being rapidly pushed forward as a continuous railway between Harrisburg and Pittsburgh. Aside from these two roads, of which the former was well advanced during the fourth decade, and the latter the only important line originated during the fifth decade, railway progress was almost suspended in the entire state, and there were few visible indications of the tremendous forward leaps that were to be made in the next decade. It would be difficult to explain fully why Pennsylvania had apparently become a Rip Van Winkle, but some of the reasons were probably furnished by the collapse of state credit, the failure of the United States Bank, chartered by the state, the disastrous financial result of the operation of a number of the state works of internal improvement, and the lack of good fortune, which had cast a blight upon some of the enterpises undertaken by private companies. The Philadelphia and Trenton, 28.20 miles in length, which had been adopted as part of the system of the United Companies of New Jersey, furnished then the most hopeful indication, and almost the only one in the entire commonwealth, that railways could be made profitable enterprises from the commencement of their existence, and this line has, perhaps, up to the present time, continuously yielded a better return on the original investment than any other line in the United States.

All the railways in Pennsylvania, at the end of 1850, according to the census returns of 1860, had an aggregate length of 822.34 miles, and had cost $41,683,054, an average of a little more than $50,700 per mile. Aside from the short coal roads leading from the anthracite regions to adjacent water channels, and the roads already named, there were scarcely any railways in Pennsylvania except those which had been constructed previous to 1840, and a very few short lines. These exceptions include the state railways, the Cumberland Valley, the Franklin, extending from Chambersburg to Hagerstown, Maryland, the Philadelphia, Germantown and Norristown, the Philadelphia, Wilmington and Baltimore (of which only 19 miles were located within the state), the Tioga (with branch), extending northward to southern New York, the Wrightsville, York and Gettysburg, and portions of the New York and Erie which crossed the boundary line into northern Pennsylvania at places where it was impossible to secure a desirable adjacent route in southern New York.

THE PENNSYLVANIA RAILROAD.

The hopes and reliance of the state, for extensive thoroughfares within her own boundaries, with a probability of securing desirable connections in western states, so far as they were then typified by actual developments, were fixed solely upon the Pennsylvania Railroad. The views prevailing a short time later in regard to this enterprise, are shown by the following extract from Andrews' Report on Colonial and Lake Trade, dated August 19th, 1852, and published as a United States government document: "The object of the Pennsylvania Railroad is to provide a better avenue for the trade between Philadelphia and the interior—one more in harmony with the works in progress and operation in other states than the main line constructed by the commonwealth. The latter is not only poorly adapted to its object, but is closed a considerable portion of the year by frost. The mercantile classes of Philadelphia have long felt the necessity of a work better adapted to their wants, and fitted to become a great route of travel as well as commerce, from the intimate relation that one bears to the other. It is by this interest that the above work was proposed, and by which the means have been furnished for its construction. The conviction of which we have spoken has been instrumental in procuring the money for this project as fast as it could be economically expended. The work has been pushed forward with extraordinary energy from its commencement. Already a great portion of the line has been brought into operation, and the whole will soon be completed.

The Pennsylvania Railroad commences at Harrisburg, and extends to Pittsburgh, a distance of 250 miles. The general route of the road is favorable, with the exception of the mountain division. The summit is crossed at about 2,200 feet above tide-water, involving gradients of 95 feet to the mile, which are less than those resorted to on the Baltimore and Ohio Railroad, and not much exceeding those profitably worked on the Western Railroad, of Massachusetts. The route is graded, and the structures are prepared for a double track, which will be laid as soon as possible after the first shall be opened. The cost of the road, for a single track, is estimated at $12,500,000, of which $9,750,000 have been already provided by stock subscriptions. The balance is to be raised by an issue of bonds. The road is to be a first-class work in every respect, and is constructed in a manner fitting the great avenue between Philadelphia and the Western states.

As a *through* route, both for trade and travel, there is hardly a work of the kind in the United States possessing greater advantages or a stronger position. Its western terminus, Pittsburgh, is already a city of nearly one hundred thousand inhabitants, and its population is rapidly increasing. That city is the seat of a large manufacturing interest, and the centre of a considerable trade, and a road connecting it with the commercial metropolis of the state cannot fail to command an immense and lucrative traffic.

The western connections which this road will make at Pittsburgh are of a most favorable character. It already has an outlet to lake Erie through the Ohio and Pennsylvania, and the Cleveland and Wellsville roads. The former of these is regarded as the appropriate extension of the Pennsylvania line to the central and western portions of Ohio. Through the Pittsburgh and Steubenville road (a work now in progress), a connection will be opened with the Steubenville and Indiana Railroad, which is in progress from Steubenville to Columbus. These lines, in connection with the Pennsylvania road, will constitute one of the shortest practicable routes between Philadelphia and central Ohio.

The Pennsylvania road must also become a route for a considerable portion of the travel between the Western states and the more northern Atlantic cities. From New York it will constitute a shorter line to central Ohio than any offered by her own works. It will, for such travel, take Philadelphia in its course—a matter of much importance to the business community.

The route occupied by the road is one of the best in the country for local traffic, possessing a fertile soil and vast mineral wealth in its coal and iron deposits. From each of these sources a large business may be anticipated. The whole road cannot fail, in time, to become the seat of a great manfacturing interest, for which the coal and iron upon the route will furnish abundant materials."

DELAWARE AND MARYLAND ROADS.

In 1850 the railways of Delaware consisted of the New Castle and Frenchtown, 16.19 miles in length, and 23 miles of the Philadelphia, Wilmington and Baltimore. Their aggregate length was 39.19 miles, and the cost of construction was $2,281,690, an average of about $58,500 per mile.

The length of the railways in Maryland in 1850 was 253.40 miles; the cost of construction was $11,580,808, an average of about $45,770 per mile. The lines consisted chiefly of 56 miles of the Philadelphia, Wilmington and Baltimore; 47.50 miles of what is now the Northern Central; 81 miles of the main line and branches of the Baltimore and Ohio, and 30 miles of its Washington branch. The only other roads in the state were short lines leading from the Cumberland coal regions, and the Annapolis and Elkridge, which had a mileage of 21.50. The Northern Central, however, had extensions in Pennsylvania, 22 miles in length, and the Baltimore and Ohio extensions in Virginia (or what is now West Virginia), 97 miles in length.

THE BALTIMORE AND OHIO.

The aggregate length of the lines of the Baltimore and Ohio in 1850, including the Washington branch, and the extensions in Virginia, was 208 miles, which had cost $15,243,426. Construction on its western extension toward Wheeling, on the Ohio river, was then being rapidly advanced, however, and Andrews' Report, dated August 19th, 1852, said:—

"The Baltimore and Ohio Railroad extends from Baltimore to Wheeling, on the Ohio river, a distance of 379 miles. Its estimated cost is $17,893,166. It crosses the Allegheny mountains at an elevation of 2,620 feet above tide-water, and 2,028 feet above low-water in the Ohio river, at Wheeling. In ascending the mountains from the east, grades of 116 feet to the mile are encountered on one plane, and for about nine miles in an opposite direction. Grades of over 100 feet to the mile, for over ten miles, are met with on other portions of the line. These grades, which only a few years since were regarded as entirely beyond the ability of the locomotive engine to ascend, are now worked at nearly the ordinary speed of trains, and are found to offer no serious obstacle to a profitable traffic. Occurring near each other, they are arranged in the most convenient manner for their economical working, by assistant power. With the above exception, the grades on this road will not compare unfavorably with those on similar works. The road is now open to a point about 300 miles from Baltimore and will be completed on or before the 1st of January next. Whatever doubt may have existed among the engineering profession, or the public, as to the ability of the road, with such physical difficulties in the way, to carry on a profitable traffic, they have been removed by its successful operation. That grades of 116 feet to the mile, for many miles, had to be resorted to, is full proof of the obstacles to be encountered. Its success in the face of all these, of a faulty mode of construction in the outset, and of great financial embarrassment, reflects the very highest credit upon the company, and upon the people of Baltimore."

VIRGINIA, NORTH CAROLINA, AND SOUTH CAROLINA.

In these states comparatively little progress was made during the fifth decade. A diversity of opinion had sprung up in Virginia in regard to the best plans to be pursued in advancing westward, which retarded progress in either of the directions proposed. Virginia, like Pennsylvania, did a comparatively small amount of railway work during the fifth decade, and a remarkably large amount of it during the sixth decade. The two railways of South Carolina, in 1850, were the Greenville and Columbia, with branches, 47.00 miles in length, and the South Carolina, with branches, 242.00 miles in length. The Louisville, Cincinnati and Charleston project having failed to accomplish the objects at which it aimed, by making the South Carolina Railroad the base of its operations, that road resumed its original name.

GEORGIA RAILROADS.

The early railroads of Georgia had been quite prosperous and successful. Much new construction was proposed and completed during the fifth decade, but at the end of 1850 the principal new achievement was the completion of the Western and Atlantic, 138 miles in length, to Chattanooga. The other railways of Georgia were the Central, 190.72 miles; Georgia, with branches, 213, and Macon and Western, 102.

GULF STATES.

The railways of the gulf states, at the end of 1850, consisted of 21 miles, the Tallahassee, in Florida; 132.50 miles in Alabama, consisting of Montgomery and West Point, with branch, 88.50 miles, and Tuscumbia and Decatur, 44 miles; 75 miles in Mississippi, consisting of Grand Gulf and Port Gibson, 8 miles, Raymond, 7 miles, and Western Mississippi, 75 miles; and 79.50 miles in Louisiana, consisting of Clinton and Port Hudson, 14 miles; Mexican Gulf, 27.00; Milnburg and Lake Pontchartrain, 4.50; New Orleans and Carrollton, with branches, 8.00, and West Feliciana, 26.

INTERIOR WESTERN STATES.

The interior Western states had commenced construction under conditions that were destined to revolutionize all preconceived ideas in regard to the financial methods that should be pursued, and the amount of new construction that could be built within a given area during a comparatively limited period. Most of these lines were intended to improve western methods for reaching markets, with comparatively little reference to the contemporaneous efforts of Atlantic seaboard cities to reach western centres of production. This double movement to and from many objective points is one of numerous causes of the extraordinary events that have characterized the rivalries of the northern trunk lines and their western connections.

As railway development was reported at the end of 1850, the lines in operation in the various states was as follows: *Kentucky.*—Lexington and Frankford, 29.18 miles; Louisville and Frankford, 49.03 miles; total, 78.21 miles. *Ohio.*—Cleveland, Columbus and Cincinnati, 135.41 miles; Columbus and Xenia, 54.56; Little Miami, 83.40; Sandusky, Dayton and Cincinnati, with branch, 173.90; Sandusky, Mansfield and Newark, with branch, 116.00; 12 miles of the Michigan Southern; total, 575.27. *Indiana.*—Indianapolis, Pittsburgh and Cleveland, 28.00; Jeffersonville, 16.00; Knightstown and Shelbyville, 27.00; Louisville, New Albany and Chicago, 35.00; Madison and Indianapolis, with branches, 86.00; Rushville and Shelbyville, 20.00; Shelbyville Lateral, 16.00; total, 228 miles. *Illinois.*—Chicago, Burlington and Quincy, 13.00; Great Western, with branch, 55.00; total, 110.50 miles. *Michigan.*—Detroit and Milwaukee, 25; Michigan Central, 226; Michigan Southern and Northern Indiana, with branches, 103; total, 354 miles. *Wisconsin.*—Milwaukee and Prairie du Chien, with branches, 20.

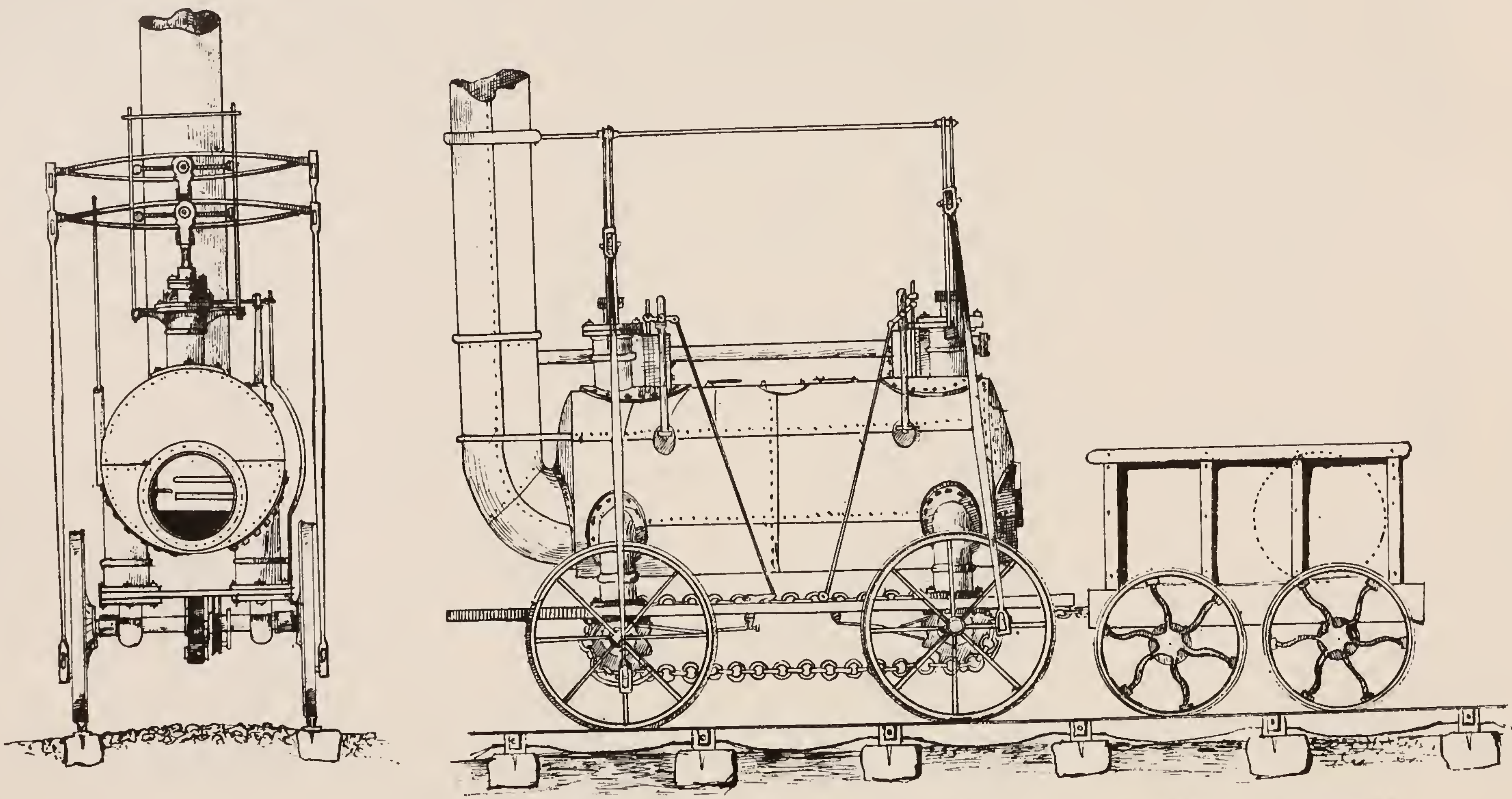
IMPORTANCE OF INTERIOR WATER ROUTES IN 1850.

TO fully comprehend the nature of the railways projected previous to 1850 it is necessary to remember the importance then possessed by the interior water routes. Through and local interior commerce drifted towards one of the two great natural water routes,—the Mississippi trending southward, and the lakes, and their eastern water outlets via the Welland Canal, the Erie Canal, or the St. Lawrence. These were the two great outlets, and, substantially, the only outlets of domestic products and inlets of merchandise.

During two centuries many exciting incidents, embracing movements of one kind or another in which civilized men had participated, had gradually helped to increase the importance of these two great water routes as aids to commercial movements. Daring explorers, devoted missionaries, adventurous fur traders, soldiers and sailors of France, Spain, Great Britain, American colonies, and the United States had, in turn, on various errands of peace, war, crafty state policy, and trade been journeying over the routes which had furnished thoroughfares for many preceding movements of the savages, who were at last being driven still further towards the Pacific by the advancing march of western emigration. The productive capacity and demands for merchandise from distant portions of the world, resulting from the rapid settlement of the western, northwestern, and south-western states, created necessities for channels over which lengthy freight movements could be made, and a choice of only two routes was presented. Indeed there were comparatively few regions which had any choice whatever, for natural conditions plainly pointed out to the people of a very large proportion of all the settlements of the Mississippi valley that their road to market was either by the river or by the lakes.

DEVELOPMENT OF LAKE TRAFFIC.

Reference has heretofore been made to some of the characteristics of the development of the western river traffic. A brief but graphic sketch of a few leading incidents typical of the growth of lake traffic is embraced in the following extract



Weight Five Tons—Draws 27 Wagons, with 94 Tons on a Level, at 4 Miles per hour.

LOCOMOTIVES CONSTRUCTED BEFORE 1826 BY GEORGE STEPHENSON.

from an account of a statement made to a correspondent of the New York Tribune, a few years ago, at Cleveland, by Uncle Davy Johnson, then 94 years of age, who was reported to be the oldest fresh-water sailor on the lakes:—

"When I was a chunk of a youngster I was apprenticed to a cooper at Bridgeport, Conn., and for five years I hammered away with adze and driver, and hauled a draw-knife for just what I put in me and on me. We used to think that western New York state or western Pennsylvania was away out west. In 1809 I put a thirty-two-pound bundle on my back, and started on foot to Buffalo. I made the journey to Albany, N. Y., about three hundred and twenty miles, in sixteen days. That journey was nothing remarkable, as I had three dollars in money and a bundle of food. Many a poor fellow started on the same journey with nothing but an axe. When I arrived at Buffalo I found a very small town. In 1812 I believe there were only three vessels on the lakes. Pittsburgh at that time was an important town. She carried on a considerable trade with the west by way of Erie. The merchandise was carted overland to Erie, and then shipped to the few ports on the great lakes.

Cleveland, Sandusky, and Erie were ports of entry. There were only two lighthouses on the lakes, one at Buffalo, first one built, and the other at Erie. Buffalo was then called Fort Erie, and was a straggling little place until the war of 1812 gave it a start. My first trip as a sailor was made from Buffalo to Erie, which was then considered quite a trip. From Buffalo to Detroit was looked upon as a long voyage, and a vessel of thirty-two tons burden was then considered the largest sailing on the lakes. In 1813 I was one of a crew of four, Captain Dick O'Neil in command, that left Buffalo in the sloop Commencement, with a cargo of whisky for Erie. While beating along the shore the English frigate Charlotte bore down upon us, and captured us. Two boat-loads of red coats boarded our vessel and took us prisoners. We were immediately paroled, and a small boat placed at our disposal to reach shore. We disliked to leave the sloop and whisky at their mercy, and asked to be allowed to remain in the vicinity of the vessel, and were told by the British commander that if it was any consolation to us we could do so. We thereupon concocted a scheme to get the guard drunk, and run the vessel ashore. This scheme was found out, and we were packed in a boat and rowed ashore, with orders not to return. After Perry's victory the owners of the Commencement were indemnified. I saw Commodore Perry often at Erie. He had his guns and munitions of war carried overland from Pittsburgh to Erie. In 1813 I settled in Cleveland. It was then a little, poverty-stricken huddle of not more than a dozen or fifteen houses. We lived in an old log-house, where the Indian Omick had been confined the year previous. He was hanged in 1812. The first vessel I sailed as captain was the Perseverance, in 1816. The first trip I made in her was from Maumee to Mackinaw, with a cargo of beer for Vance and Meeker. Vance was afterward Governor of Ohio. From that time on I sailed the lakes for fifty years."

RELATIVE IMPORTANCE OF THE RIVAL THROUGH ROUTES.

The reported value of property received at seaboard by the Mississippi was $106,924,083 in 1850, and $108,051,708 in 1851. It was more than doubled during the fifth decade, being $45,716,045 in 1841 and $53,782,054 in 1842. The value of property received at seaboard by the Hudson and St. Lawrence was much smaller, being, in 1851, $9,153,580 via the St. Lawrence, and $53,027,508 via the canals and Hudson. The New York railroads, however, had even then diverted a portion of the interior and lake traffic, and it was reported that they had delivered property valued at $11,405,350. Of the east-bound movement going over the New York canals, 887,891 tons, valued at $25,471,962, was received from other states than New York. The movement toward the interior was much greater by the northern canal and lake route than by the Mississippi, their reported relative magnitude in 1851 being as follows: New York canals, $80,739,899; New York railroads, $44,556,000; St. Lawrence, $10,956,793; Mississippi, $38,874,782. The amount of the through tonnage sent westward over the Portage Railroad, Pennsylvania, in 1851, was 10,961 tons, valued at $2,779,731. The east-bound movement over this road in 1851 was only 13,696 tons, valued at $125,000.

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The competition between the two great water routes was more active in reference to the commercial movements of Ohio than any other state, partly because it was then the richest and most productive of the Western states, Cincinnati being the most populous of western cities, but more particularly because geographical location and the characteristics of the transportation systems then available furnished good reasons for a division between the two water routes of the traffic of different sections and of different descriptions. The debatable ground in Ohio frequently shifted with the seasons, or from one year to another. From Cincinnati nearly all bulky products were shipped south-west by river, either to find a market in Southern states or an outlet, through New Orleans, to foreign countries. In the northern part of the state it was most convenient and profitable to conduct trade over lake channels, and it was chiefly through them that a large proportion of the imports of merchandise consumed in Ohio were made. An intelligent writer of the period, in discussing this subject, says that "the greater quantity of flour and grain is exported from the lake ports, but the larger proportion of live stock, animals, provision, and whisky pass through the river ports." He thought that the line of separation, in regard to the productions of Ohio, was very near to the centre of the state, and said that "nothing of domestic produce, in the immediate Ohio valley, except, perhaps, tobacco, wool, and manufactured articles, go to the lake ports. In the articles of tobacco and wool, the trade almost altogether tends lakewards."

An analogous state of things existed in Indiana and Illinois, but with a more decided tendency to the river route. The trade of Michigan, on the other hand, was conducted almost exclusively on the lakes. The tendency of railroads running east and west to divert western traffic to Atlantic ports was beginning to be exhibited by operations of the Michigan Central, running between Detroit and Chicago, which, in 1851, carried 129,387 tons of produce and merchandise, 91,145 tons (of which 49,136 tons were flour and 17,202 tons wheat), being sent eastward, mainly to Detroit, and 38,242 tons westward. The commercial interests of Chicago, then gradually rising in importance, were also identified with the lake routes to an extent that was giving direction to the railway projects of the period planned or favored in Illinois, and that subsequently led to the construction of numerous lines which have had a powerful effect in attracting commerce from the river to the lake route. The bulky produce of Kentucky, Tennessee, Missouri, and all other states bordering on the Mississippi, naturally drifted to the river route. It furnished the only channel then available. In brief, it was only the western regions in comparatively high latitudes and adjacent to the lakes that could trade with the world through them, and nearly the entire Mississippi valley, as it was then developed, was commercially dependent upon and tributary to New Orleans.

Independent of the commercial through movement on the Mississippi and the lake route, numerous cities and towns had sprung up, and a large local river and lake trade was being conducted. The domestic or coastwise trade of the lakes in 1851 was valued at $314,473,458. The gross value of the river commerce (mainly on the Mississippi and its tributaries) was valued in the same year at $339,502,744. The coasting trade, along the Atlantic, the gulf of Mexico, and the Pacific had a much greater estimated value than the trade of the rivers and lakes combined, and the railways and canals were rapidly rising in importance as intermediate carriers between the eastern and western avenues of domestic trade, and at the same time achieving much in the way of promoting local development.

THE EXTENT OF THE WESTERN RIVER ROUTES

is indicated by the following estimates published about 1850 of the probable extent of steam navigation on the western waters, including the rivers, bayous, &c., connected with the Mississippi by channels navigable for steamers, 16,674 miles:—

Mississippi and Branches, Bayous, &c.

	Miles.		Miles.
Mississippi proper	2,000	Black	60
St. Croix	80	Wisconsin	180
St. Peters	120	Rock	250
Chippewa	70	Iowa	110

	Miles.		Miles.
Cedar	60	Neosho	60
Des Moines	250	Yazoo	300
Illinois	245	Tallahatchee	300
Maremec	60	Yalabusha	130
Kaskaski	150	Big Sunflower	80
Big Muddy	5	Little Sunflower	70
Obion	60	Big Black	150
Forked Deer	195	Bayou de Glaze	90
Big Hatchee	75	Bayou de Care	140
St. Francis	300	Bayou Rouge	40
White	500	Bayou La Fourge	60
Big Black	60	Bayou Plaquemine	12
Spring	50	Bayou de Teche	96
Arkansas (navigable at high water, 850)	600	Grand River	12
		Bayou Sorrele	12
Canadian	60	Bayou Chien	

Missouri and Branches.

	Miles.		Miles.
Missouri proper (during part of the year)	1,800	Kansas	150
Yellow Stone	300	Osage	275
Platte, or Nebraska	40	Grande	90

Ohio and Branches.

	Miles.		Miles.
Ohio proper	1,000	Kentucky	62
Allegheny	200	Salt River	35
Monongahela	60	Green	150
Muskingum	70	Barren	30
Kanawha	65	Wabash	400
Big Sandy	50	Cumberland	400
Scioto	50	Tennessee	720

Red River and Branches, Bayous, &c.

	Miles.		Miles.
Red River proper	1,500	Tensas river	150
Wachita	375	Lake Bistenaw	60
Saline	100	Lake Caddo	75
Little Missouri	50	Sulphur Fork	100
Bayou D'Arboune	60	Little river	65
Bayou Bartholomew	150	Kiamichi	40
Bayou Bœuf	150	Boggy	40
Bayou Macon	175	Bayou Pierre	150
Bayou Louis	30	Atchafalaya	360

STEAM TONNAGE OF WESTERN RIVERS.

Official reports made to the United States Treasury Department in 1842 stated in detail the steamboat tonnage on the Mississippi and its tributaries in that year. The following table shows the increase from 1842 to 1851:—

Districts.	Tonnage. 1842.	Tonnage. 1851.	Increase.	Decrease.
New Orleans	28,153	34,736	6,583	....
St. Louis	14,725	31,834	17,109	....
Cincinnati	12,025	24,709	12,684	....
Pittsburgh	10,107	16,943	6,836	....
Louisville	4,618	15,181	10,563	....
Nashville	3,810	3,578	....	232
Wheeling	2,595	7,191	4,596	....
Vicksburg	....	938	938	....
Memphis	....	450	450	....
Total	76,033	135,560	59,759	232

While the increase was rapid, as the steamboat tonnage of the Mississippi valley had nearly doubled itself in nine years, a large proportion of the down-river freight movements were still made, as they have been at all periods, by other craft, including such as have already been described in discussions of water movements on rivers. The average size of steamboats on the Ohio basin in 1851 was $206\frac{3}{9}\frac{3}{5}$ tons, and those of the Lower and Upper Mississippi, the Arkansas, the Missouri, and the Illinois rivers, $273\frac{3}{5}\frac{4}{9}$. On the Mississippi and Ohio there were many steamers of from 300 to 500 tons each, and a number from 600 to 800 each; but the large number of light-draught boats, built to run in periods of low water on those rivers, and in all seasons on smaller tributary streams, carried the general average down to the figures given above.

TONNAGE OF THE LAKES.

The steam tonnage of the lakes, as reported in 1851, was as follows:—

Districts.	Tonnage, 1851.
Buffalo creek	25,990
Presque Isle	5,691
Cuyahoga	6,418
Miami	1,745
Detroit	16,469
Mackinaw	1,746
Chicago	652
	58,711

The average size of the steamboats running on the lakes was 437 tons, but several of the passenger steamers of the lakes were of 1,100 tons or more.

The total tonnage of the lakes in 1850 was reported to be 215,787, the bulk of which consisted of sailing vessels. In 1840 this tonnage was but 75,000, and the rapid increase was one of the indications of the growth of settlements and trade of the Western and North-western states bordering on the lakes.

The following statement of the

POPULATION OF LAKE AND RIVER CITIES,

excluding cities near the Atlantic seaboard, in 1850, affords an indication of the extent to which water-route connections had helped to concentrate population at the points named up to that time:—

Buffalo, 42,261; Rochester, 36,403; Pittsburgh, 46,601; Allegheny City, 21,161; Nashville, 10,478; Louisville, 43,194; Cincinnati, 115,346; Cleveland, 17,034; Detroit, 21,019; Chicago, 29,963; St. Louis, 77,860; New Orleans, 116,375; Milwaukee, 20,061; Wheeling, 11,435; Vicksburg, 3,678; Natchez, 4,434; Memphis, 8,839; Burlington, Iowa, 4,082.

STATISTICAL POSITION OF THE COMPETING SYSTEMS.

RELATIVE RANK OF RAIL AND WATER MOVEMENTS.

In comparison with water movements on the canals, ocean, gulf, lakes, and rivers, railway movements, so far as they were represented by the number of persons employed, make but an insignificant showing in the census report of 1850. It states that 116,341 persons were employed in sea and river navigation. Its table of occupations of the male population over fifteen years of age gives the following figures: Boatmen, 32,454; mariners, 70,603; railroad men, 4,831. The "railroad men" were located as follows: Maine, 171; New Hampshire, 247; Vermont, 163; Massachusetts, 788; Connecticut, 136; New York, 1,769; New Jersey, 135; Pennsylvania, 546; Delaware, 7; Maryland, 201; District of Columbia, 3; Virginia, 91; North Carolina, 22; South Carolina, 73; Georgia, 127; Alabama, 13; Mississippi, 6; Louisiana, 6; Kentucky, 7; Ohio, 40; Michigan, 28; Indiana, 227; Illinois, 22; Wisconsin, 3.

One subdivision of the census returns of 1850 reports that 56,025 persons were employed in navigating the ocean and 33,067 in internal navigation. The latter presumably represent movements on rivers, canals, and lakes. Sectionally they were classified as follows: New England states, 1,914; Middle states, 17,577; Southern states, 4,149; South-western states, 1,861; North-western states, 7,566. The number of persons reported to be engaged in internal navigation in each state was as follows: Maine, 539; New Hampshire, 198; Vermont, 146; Massachusetts, 372; Rhode Island, 228; Connecticut, 431; New York, 10,167; New Jersey, 1,625; Pennsylvania, 3,951; Delaware, 235; Maryland, 1,519; District of Columbia, 80; Virginia, 2,952; North Carolina, 379; South Carolina, 348; Georgia, 352; Florida, 118; Alabama, 758; Mississippi, 100; Louisiana, 662; Arkansas, 39; Tennessee, 302; Missouri, 1,885; Kentucky, 968; Ohio, 3,323; Indiana, 627; Illinois, 310; Michigan, 166; Wisconsin, 209; Iowa, 78.

These expressive figures illustrate more forcibly than pages of comment the extent to which interior water channels exceeded railways as channels for the conveyance of produce and merchandise in 1850.

POSTAL SERVICE BY VARIOUS METHODS.

Another interesting test of the relative rank of railways, as compared with other agencies of transportation, at different periods, is furnished by reports of the operations of the Post Office Department, and the amount of service by rail, steamboat, coaches, &c. Indications of the extent to which the railroad was gradually gaining ground are furnished by the following extracts and statements from the annual report of the Postmaster-General, dated December 3d, 1849:—

MAIL SERVICE OF 1848 AND 1849 COMPARED.

	1848. Miles.	1848. Cost.	1849. Miles.	1849. Cost.
Length of post routes....	163,208	$......	167,703	$......
Annual transportation, mode not specified....	17,774,191	751,500	18,573,364	777,415
Annual transportation, coach....	14,555,188	796,992	15,025,552	736,710
Annual transportation, steamboat....	4,385,800	262,019	4,083,976	278,650
Annual transportation, railroad....	4,327,400	584,192	4,861,177	635,740
Total annual transportation within the United States....	41,012,579	$2,394,703	42,544,069	$2,428,515

It will be seen that in 1848 the mileage of steamboat service exceeded that of railroad service by 58,400, while in 1849 the railroad service exceeded that of the steamboat by 777,201. Meanwhile the length of service by roads not specified and by coach had also increased, and their aggregate mileage in 1849 was 33,598,916, or nearly seven times the amount of railway mileage, although the length of all the post routes in the country was only 163,208 miles.

The report of the Postmaster-General shows that in addition to the increase of railroad service noted above there had been an additional gain during the progress of the year 1849, as new lines had been opened. Under the head of railroad service it says: "This is a constantly increasing service. In the current year the length of railroad routes is 6,138 miles, being an increase, within two years, of 1,149 miles; and it is almost daily increasing as new roads are being completed. On these routes the mail is now transported 5,749,400 miles annually."

A table is also published in the report which shows the length of routes and manner in which service was performed in each state during the year ending June 30th, 1849. As it furnishes an indication of the relative importance of each transportation agency, the extent to which railways and steamboats were employed, and the length of the routes over which the mail was carried on the roads or turnpikes in each state, we compile from it the following statements:—

States.	Length of route. Miles.	Mode not specified. Miles.	In coach. Miles.	In steamboat. Miles.	By railroad. Miles.
Maine....	4,284	3,410	780	....	94
New Hampshire....	2,213	1,119	962	....	132
Vermont....	2,519	1,422	1,027	70	....
Massachusetts....	3,241	840	1,443	108	850
Rhode Island....	434	240	146	....	41
Connecticut....	1,780	1,160	374	....	246
New York....	13,548	7,976	3,567	1,104	901
New Jersey....	2,172	901	1,033	28	210
Pennsylvania....	10,744	6,517	3,882	....	315
Delaware....	482	272	210	....	....
Maryland....	2,271	1,279	576	....	416
Virginia....	11,634	8,917	1,907	514	296
North Carolina....	7,798	5,733	1,536	282	247
South Carolina....	5,349	3,551	671	880	247
Georgia....	6,523	4,966	594	358	605
Florida....	1,876	1,204	392	280	....
Ohio....	12,042	7,390	3,548	824	280
Michigan....	4,419	3,080	867	124	344
Indiana....	6,964	5,851	1,026	....	87
Illinois....	8,970	5,787	3,183	....	....
Wisconsin....	3,823	3,242	581	....	....
Iowa....	3,254	2,808	446	....	....
Missouri....	9,163	6,378	1,329	1,456	....
Kentucky....	8,535	5,677	1,091	1,767	....
Tennessee....	7,126	5,285	1,841	....	....
Alabama....	7,107	5,541	1,204	259	103
Mississippi....	4,747	3,933	693	75	46
Arkansas....	5,463	4,720	465	278	....
Louisiana....	3,888	2,556	137	1,195	....
Texas....	15,344	4,527	727	80	....
Total....	167,703	116,286	36,238	9,682	5,497

Notes to the table explain that the entire service and pay are set down to the state under which it is numbered, though extending into other states, instead of being divided among the states in which each portion of the service is rendered. Thus the Philadelphia, Wilmington and Baltimore Railroad was set down under a Maryland number, and all its mail service was credited to Maryland, although in reality portions of it were performed in Delaware and Pennsylvania. The same system prevailed in relation to steamboat service. Thus, 1,767 miles of steamboat service credited to Kentucky, exclusively, really embraced steamboat service from Louisville to Cincinnati, and from Louisville to New Orleans, including the carriage of mail matter for residents of a number of states bordering on the Ohio and Lower Mississippi.

Making due allowance for this system, the character of the mail mileage of each state given above furnishes probably the best attainable data in regard to the nature and length of the routes over which persons and property could be moved in the United States in 1849. Few settlements of considerable importance, except newly-settled districts, like those of California, were remote from mail routes; and yet on these the bulk of the service, or the service on routes 116,286 miles in length, out of a total length of 167,703, was rendered by modes not specified, which presumably means, in nearly all instances, that it was over roads on which stage lines were not running, while on 36,238 miles of the routes service was rendered in coaches that traversed roads extending through districts in which there was a sufficient population to justify such enterprises. It is also noticeable that the land routes combined had an aggregate length of 158,021 miles, while the length of the water or steamboat mail routes was 9,682 miles, and this disproportion approximately represents the difference then existing, and which has been steadily increasing ever since, between the magnitude of the mileage of routes that can only be served by land carriers of one kind or another and the mileage of districts best served by water carriers.

THE MOST PROMINENT FEATURES OF TRANSPORTATION DEVELOPMENT,

in a broad, national sense, in 1850, were probably these:—

1. Water routes, including the Atlantic and the gulf, continued to furnish the principal freight avenues of the country, and the magnitude of the business transacted on the Mississippi and its tributaries, and the lakes, had greatly increased during the previous ten years.

2. Railways were beginning to institute serious rivalry with a few of the water routes, such as the carriage of coal by the Reading railroad from the Schuylkill regions to tide-waters in competition with the Schuylkill Canal, and the carriage of flour over the New York Central in competition with the Erie Canal, and railways were rapidly increasing in usefulness as freight carriers over inland districts, over routes adjacent to water lines during winter months, and as forwarders of merchandise requiring quick transit at all seasons.

3. As all extensive traffic movements had been conducted on water routes, and as the creation of new traffic in inland regions was a comparatively slow process, the field for service as freight carriers by the railways was comparatively limited, unless they could add to the function of connecting water routes direct competition with some of the labors performed upon water. The conclusion was reached at an early day that railways could successfully compete with canals owned and operated by private companies, but how far they could compete with rivers and lakes has been a disputed question at nearly all periods, the practical decisions reached varying with the respective excellence of various water routes, the amount of money spent by governments for their improvement, and

their location. An abstract of the census report of 1850 says: "The usefulness and comparative economy of railroads as channels of commerce and travel have become so evident that they have in some measure superseded canals, and are likely to detract seriously from the importance of navigable rivers for like purposes." The contest would be less hopeful for the railways if frigid winters did not close some of the most important of the water routes during a considerable portion of each year, thus temporarily leaving the railways in uninterrupted control of the traffic.

4. The apparent arenas of railway usefulness, independent of short local lines, were intimately interwoven with the pre-existing water systems of transportation. There were very few, if any, lengthy railway lines constructed up to 1850 (except those which formed links in the great chain between northern and southern states, and which were generally intended to serve mainly as passenger routes, rather than as freight carriers), that did not aim either at paralleling river or lake routes, or establishing connections between comparatively distant water routes, such as the Ohio or Mississippi and the lakes, and eastern tidal rivers and western water routes. All the lengthy east and west rail routes of the Atlantic states were intended to facilitate connection between the seaboard or its vicinity and the interior lake or river systems, and nearly all western railways were intended to lead to or from the lakes, the Ohio, or the Mississippi. The water routes continued to be the base of all extensive transportation movements.

5. In some cases rivalries between rail and water routes sprang up, and in others the new rail and old water systems were cordial allies. The economic question of most serious importance was how cheaply freight movements could be made by rail, and on the solution of this problem a large proportion of the subsequent industrial and transportation movements of the entire country has hinged.

The progress made in the physical condition of railways, improvements in rolling stock, and increase of the power of locomotives, led to the belief shortly after 1850 that it might be possible, under favorable circumstances, to move freight in large quantities over long distances at the rate of 1.5 cents per ton per mile. This was a much lower rate than the average charges, or even the reported cost of movements on important railways of that era, and very far below the rates usually charged. But the fact was constantly becoming more and more clearly established every year that the possible cheapness of rail movements had been greatly underrated by the pioneer railway engineers. Still such a thing as railway competition with water routes over a long distance, such as a movement from Chicago to New York, for instance, could scarcely have been thought of in any circles. Even at 1.5 cents per ton per mile it would mean a charge of $15.

RAILWAY FINANCIERING.

THE official abstract of the census of 1850, dated December, 1852, in discussing the cost of American railways up to that time, and methods by which capital had been procured, says:—

"The subjoined table, prepared for the most part from actual returns, exhibits the amount expended upon roads in operation on the 31st of December, 1851:—

New England states	$131,940,000
New York	76,000,000
New Jersey	9,040,000
Pennsylvania, Delaware, Maryland, and Virginia	81,600,000
North Carolina	3,800,000
South Carolina	9,860,000
Georgia	13,000,000
Mississippi	1,400,000
Alabama	2,000,000
Louisiana	1,000,000
Tennessee	2,000,000
Kentucky	1,670,000
Ohio	17,560,000
Indiana	9,000,000
Illinois	2,600,000
Michigan	10,000,000
Wisconsin	300,000
Cost of completed roads in the United States	$372,770,000
Probable cost of those in progress	220,000,000
Total amount of capital invested (and about to be invested) in railroads, December 31st, 1851	$592,770,000

The average cost of American railroads completed previous to the commencement of 1852 was $34,307 per mile. . . . In the infancy of the American railroad system, a favorite means of providing funds for their construction was the advance of loans from the treasuries of the respective states in which they were situated; but this plan has been superseded by the use of private capital, and, within the last ten years, frequent recourse has been had to the expedient of loans and subscription by counties, cities, and towns through which the roads pass. Loans of this character, however, are in all cases made under the sanction of authority conferred by the state legislatures. The bonds representing these transactions, with the stocks of the companies, have been estimated to amount to $300,000,000. This sum may be assumed as the amount of capital invested in these roads now in progress, and those which may have been completed since the opening of the year. If, then, we add this sum to the estimated cost of the roads finished in December, 1851, we have $662,770,000 as the total amount of investments in railroads in the United States."

TRANSITION TOWARDS AN INCREASE OF BONDED INDEBTEDNESS.

Previous to 1850 a relatively small proportion of the cost of railway construction was represented by bonds of the companies by which the various lines were operated, but about that time, or shortly afterwards, the custom became more and more common of obtaining a large proportion of the capital actually used in construction and permanent improvements in exchange for railway bonds, and this custom has since been adhered to with so much pertinacity, intermingled with many abuses, that the proportion of the real capital expended on new lines furnished by purchasers of bonds has been steadily increasing. Before 1850 there were comparatively few companies which could obtain large amounts of money in financial marts, or from bankers, by issuing bonds. When it is considered that even the credit of a number of states had been tarnished by failure to provide promptly for the payment of interest on their bonds, although such bonds were secured not merely by the public works, consisting of canals in some instances and railways in others, upon which the proceeds of loans had been expended, but also by all the resources of the respective commonwealths, it is not surprising that capitalists were not generally disposed to advance large sums to companies whose properties could at best represent only a small fraction of the security which was apparently furnished by a state bond. There were a few variations from this rule, however, and the New York and Erie was one of the companies which was able about 1850 to negotiate a 7 per cent. loan of several millions of dollars at about 90, or giving a $1,000 bond for $900. This was considered a great achievement, and was perhaps only rendered possible by the previous action of the state of New York in relieving the company of the pressure of its obligation for an advance of $3,000,000. The Pennsylvania Railroad was commenced with the hope that *bona fide* stock subscriptions would furnish all the capital needed to complete its main line, and the expectation was so far fulfilled, through the aid of the subscriptions of cities interested in the prosecution of the work, that the main line was nearly finished before a loan was seriously considered, and then only one-fifth of the total sum required was to be raised by an issue of bonds.

At the outset of this enterprise few persons expected it to become a remunerative undertaking. The city of Philadelphia was canvassed by committees, going from house to house and block to block, earnestly endeavoring to secure subscriptions to the stock, on the ground that the road was necessary to promote the growth and prosperity of the city, and that even if no dividends were ever paid the indirect benefits conferred upon all whose industrial or commercial welfare was identified with that municipality would fully compensate them for the loss of the capital paid for stock. Under the pressure of such appeals many persons subscribed for five shares, par value $50 each, to be paid for in a number of instalments, with the expectation that the entire amount, or $250, would be unremunerative and, perhaps, worthless, as an investment, but they could afford to lose that sum if the prospective benefits could be conferred upon the city. In a number of instances subscriptions for a single share of stock were also solicited and obtained. This species of canvassing was conducted in connection with the formation of a number of other companies, but there were probably few or no instances in which exertions of the kind indicated were more industrious and energetic, and the prospect of direct financial benefits less encouraging than in the case of the original individual subscriptions to the stock of the Pennsylvania Railroad Company. This subject is referred to in one of its earliest reports, made after a short portion of its contemplated line was opened, and found to be capable of earning the interest on its cost, and the important announcement is made that during that year a noticeable change in public sentiment had occurred in regard to the prospects of its becoming a paying enterprise, chiefly in consequence of the fact that a freshet had temporarily destroyed, during an entire season, the usefulness of the Juniata Canal, and thus made it evident that only a railway could furnish a reliable agency of cheap transportation between Philadelphia and Pittsburgh.

The Baltimore and Ohio was liberally aided by loans or subscriptions of the city of Baltimore and the state of Maryland. Its construction had been delayed by the difficulty of disposing of the securities of these efficient helpers. A subscription of $3,000,000, by the city of Baltimore, was made available during a suspension of specie payments, by issuing orders redeemable in the city's obligations; and a $3,000,000 subscription of the state of Maryland remained unavailable until a comparatively late period in the history of the construction of that road, on account of a requirement that the state bonds should not be sold for less than their par value.

Shortly after 1850 many schemes were projected which were based on the idea that after half the cost of a road had been contributed or assured by *bona fide* stockholders, or by subscriptions of cities, towns, or counties, in actual cash, it was a safe and prudent thing for all concerned, to issue bonds representing the other half of the cost of construction., Those who advocated this plan laid great stress upon the importance of the first half of stock subscriptions being actually or virtually paid in; and it is probable that there were few or no railways built in the United States, by a private company, before 1850, in which such payments had not been substantially made. It was indeed only a few companies which enjoyed specially good fortune and credit that could borrow a sum, on bonds, equal to the real capital advanced by stockholders; whereas, after the custom of making bonded indebtedness nominally equal to stock capital became general, the tendency soon began to display itself of lessening the degree of fidelity or regularity with which the full amount of the theoretical share capital was actually paid into the treasuries of the companies which issued bonds. On the extent to which such departures have since occurred many of the most serious misfortunes of struggling companies, losses of unfortunate investors, and discreditable episodes in railway history, have hinged.

STATE AID AND STATE OWNERSHIP.

The change in the methods by which a large proportion of railway capital was secured, and in the character of the securities by which it was represented, and the abandonment of the practice of extending liberal state aid, in the shape of loans or stock subscriptions to important companies, was either accompanied or soon followed by a noticeable change in the character of the relations between railway companies and the states in which the lines were located. Originally it seems to have been taken for granted that the property of the important companies would finally be purchased by the states which granted the first charters. It was quite common in early charters to provide that after the lapse of a certain number of years the states should have the right to take possession of the property of the companies, provided stockholders and creditors were fully compensated for such a change of ownership. A broad basis was thus laid for a system analogous to that established in France, which fixed a period when, in exchange for financial guarantees or advances made by the government, and other considerations, it should become proprietor of all the railway lines within its territory. The time fixed for the transfer of the ownership of the property of a number of the early American companies has long since expired, and there has probably not been a single instance in which a desire to assume state ownership was seriously entertained. The reverse process, or the disposal of railways or canals, originally built or partly constructed by states, to private companies, has been conducted on a comparatively extensive scale. The states which have built or undertaken to build railways on their own account include Pennsylvania, Massachusetts, North Carolina, Georgia, Indiana, Michigan, and Illinois, and a number of other commonwealths have advanced considerable sums to promote railway construction, but the results of attempts to operate railways by state officials, and at the risk of state tax-payers, have been so uniformly disastrous that modern advocates of state ownership and management would find in the record of these mishaps serious objections to an application of their theories to the railways of this country.

Of all the states which built railways outright, Michigan was perhaps the most fortunate, in a financial sense, as she was able to sell the line of 144 miles, leading from Detroit to Kalamazoo, which had cost $2,500,000, to the Michigan Central Railroad Company in 1846 for $2,000,000. The experiment of Massachusetts, commenced at a much later day, which cost her nearly $14,000,000, generally fails to yield a sufficient net revenue to pay the expenses of keeping the road and Hoosac tunnel in proper condition, as a considerable annual appropriation for this purpose is required. The result of the operation of the Allegheny Portage Railroad by the state of Pennsylvania up to January 1st, 1852, was a gross revenue of $2,985,769.10, and current expenditures of $3,161,327.26, while its cost had been $1,860,752.76. The operations of the Columbia and Philadelphia, which had cost $4,791,548.91, had been more fortunate. As it was located on one of the best routes for a railway in the United States, its officers sometimes reported that it was earning the interest of its cost, and up to January 1st, 1852, its gross revenues had been $7,483,395.53, and operating expenditures, repairs, &c., $5,105,058.39. The Pennsylvania system of public works, as an entirety, had been a serious burden to the people, as a number of the canals, like the Portage Railroad, had failed to earn a sufficient amount to keep them in repair and pay for cost of superintendence.

Their usefulness was diminished by the extent to which partisan influences and variations in legislative policy prevented a due regard for legitimate business considerations. Like nearly all systems of government works in this country, it was necessary to make appropriations for some works which could scarcely be expected to prove remunerative, to secure the necessary number of legislative votes for works of great utility One of the proposed railroads which the state of Pennsylvania graded at considerable expense, the Gettysburg, was wholly abandoned. Reliable employés were subject to a discharge when a change in the politics of the party in power occurred, and, therefore, sought service from private companies. There were serious scandals, too, relating to various methods of defrauding the state.

THE EXPERIENCE OF ILLINOIS IN STATE RAILROAD CONSTRUCTION and management was exceptionally disastrous, and in some respects it was an exaggerated illustration or caricature of the results elsewhere. W. K. Ackerman gives this instructive epitome of the experience of Illinois in a paper read before the Chicago Historical Society in 1883:—

"On the 27th of February, 1837, the internal improvement act was passed, under which the state of Illinois undertook to build about 1,340 miles of railroad, improve every navigable stream in the state, and, as a healing balm to those who felt no particular interest in the building of railroads or improvement of rivers, $200,000 was appropriated 'for the improvement of roads and bridges in counties through which no railroad or canal passed.'

Section 25 of the act provided that the construction of the railroads should be commenced simultaneously at each end—at important trading towns, and at their intersections with navigable streams, to be thence built in both directions. This was owing to a jealous fear on the part of those living at different points along the proposed route that one section might gain some advantage over the other.

Under this act a board of fund commissioners was appointed, consisting of three members, who were to be 'practical and experienced financiers.'

Provision was made in the 42d section of the bill 'for putting up conspicuously, and maintaining across each turnpike road and highway, boards on which there was to be painted in capital letters of at least nine inches in length:—

'Railroad Crossing—Look out for the engine while the bell rings.'

Alas, they looked up but saw nothing.

The act authorized the expenditure of over $10,000,000 (equivalent to an appropriation of $200,000,000 on the basis of the present population of the state), for the payment of which the faith of the state was 'irrevocably pledged.'

Brown, in his History of Illinois, says: 'The state of Illinois was then in debt. Its revenue was insufficient to defray the ordinary expenses of government.

'The school fund had been borrowed by the legislature, and expended, and the idea of taxation to pay interest or principal, it is believed, was scarcely thought of. Had taxation then, or at any other time, been suggested, the bill would unquestionably have been lost.

'The thought, however, of taxation either never occurred or its necessity, at least in imagination, was removed so far distant that it caused no terror.'

THE NORTHERN CROSS ROAD.

Under this act, only one railroad (that projected from Meredosia, on the Illinois river, to Springfield, and known as the Northern Cross road), was actually completed. Under a special provision in the bill, work was commenced on it first, the surveys having been started on the 11th of May, 1837. The first rail was laid on the 9th of May, 1838, and on November 8th of that year the first locomotive used in the state, which had arrived at Meredosia in September, was placed on the track.

The road was completed to Jacksonville by January 1st, 1840.

The second locomotive brought to the state was for the same road. It was built by M. W. Baldwin, of Philadelphia, and was called the Illinois.

This was the first locomotive to reach a point near Springfield, arriving there on February 15th, 1842, after the line had been extended nearly up to that city. The Springfield Journal, of March 18th, 1842, stated that 'the cars ran from Jacksonville, 33½ miles, in two hours and eight minutes, including stoppages. It is believed that the distance can be passed over in an hour and a half. Trips continue to be made three times per week.'

HOW IT WAS CONSTRUCTED.

The road was constructed by spiking flat strips of iron on to long timbers, which were laid lengthwise the tracks, and which were kept from spreading by cross-pieces inserted every five or six feet. In a short time the road and engines needed repairing, and the engines were taken off, and mule teams used for some years in their place.

The 24 miles of road extending from Meredosia to Jacksonville cost the state over $400,000, and was the only piece of road built by the state that was ever operated by it.

The entire line from Meredosia to Springfield, 58 miles in all, was finally completed May 13th, 1842, at a cost of nearly $1,000,000.

Its whole income was insufficient to keep it in repair, and its operation was abandoned by the state.

The road was sold in 1847 by authority of an act of the legislature, and realized $21,100 in state indebtedness. The purchasers were Charles Ridgeley and Colonel Thomas Mather, who shortly afterward transferred to parties in New York, who, under an organization known as the Sangamon and Morgan Railroad Company, reconstructed the line, and opened it for business in 1849.

It was afterward called the Great Western Railway Company of 1849 to distinguish it from the numerous Great Western companies that had been organized in the state, and it now forms part of the Wabash, St. Louis and Pacific Railway.

Some other roads authorized under this act were commenced, and partly finished. This whole work of state railroads was finally abandoned, leaving the state with a debt on this account of over $6,000,000."

FINANCIAL RESULTS OF RAILWAY OPERATIONS.

IN reference to the financial results of railway operations during the fifth decade, an abstract of the census report of 1850 said:—

"From the best data accessible at this time, we prepare the following table, representing the financial condition of some of the states, selected as affording a fair exemplification of the whole system in this country:—

	Length of roads.	Aggregate cost.	Net income.	Declared dividends.	Estimated actual profits.
Massachusetts	1,089	$52,595,288	$3,260,670	6.2	7.5
New York	1,826	76,000,000	4,023,000	5.0	9.44
Georgia	754	13,000,000	......	7.5	10.00

The figures under the head of 'estimated actual profits' present the assumed net income after the addition of the dividend of the surplus earnings, reserved profits, and all receipts in excess of expenditure not included in the calculation of which the dividend is a result."

This statement gives rather a roseate view of the actual condition of a number of companies, as some of them had proved unprofitable, but the fact is undeniable that a considerable proportion of the lines were quite profitable, perhaps more profitable than at any subsequent period. It was an era of high charges for many kinds of service, especially for freight movements, and comparatively small expenditures either for salaries and wages, or improvements of roadway or rolling stock. The era of serious competition between railway lines had scarcely commenced. In a few cases very high dividends were paid.

On the other hand, companies had been exposed to very severe financial strains or losses, arising from the panic of 1837 and the subsequent effects of the collapse of state credit during the fifth decade, the inadequacy of available means, or other causes. Some minor projects were abandoned during a protracted period after considerable expenditures for excavations and grading had been made, and some of the more ambitious undertakings, which involved the construction of lengthy lines were obliged to postpone the completion or natural extension of their works for many years. Referring to such disasters David A. Neal, in a report on the Reading, made in January, 1850, says: "Great avenues can be constructed, as experience shows, only at enormous outlays and with doubtful results. The corporations that have constructed them heretofore have all become bankrupt, and there would seem to be no inducement for seeking the same end by the same means. Insane speculators there always will be, but they seldom take a beaten path to ruin. They have too much self-esteem to follow others." Solomon W. Roberts, in a report on the Ohio and Pennsylvania Railroad, made in 1850, says: "One main cause of the remarkable success of the railroad companies in New England has been their not beginning more than they were able to finish; and the losses on such enterprises experienced in some other parts of the Union, are to be attributed not so much to bad engineering, as to the pursuit of a contrary policy, which, preferring the counsel of hope to that of experience, and beginning the work along an extended line with insufficient capital, has resulted too often in swamping the company in debt, and compelling it to submit to injurious financial sacrifices."

Of the railroads of Massachusetts it was reported in 1850 that they had cost $51,885,556; that their expenses were $3,410,324; and their income $6,300,662. In that year they carried 9,500,000 passengers and 2,500,000 tons of freight.

The Baltimore and Ohio Railroad report of 1851 gives the following comparison of the cost of construction and operation upon eight leading railroads of the United States, compiled from the most recently published reports:—

Name of road.	Length in miles.	Cost of road and equipment.	Cost per mile.	Receipts from passengers.	Receipts from tonnage, mails, &c.	Expenses, inclusive of interest.
1. Boston and Lowell and branches.....	27½	$1,945,646	$70,751	$177,372	$229,048	$256,509
2. Boston and Providence & branches.	53	3,416,232	64,457	232,321	138,406	159,280
3. Boston and Worcester & branches.	68¾	4,882,648	71,020	397,249	360,698	377,041
4. Eastern..........	58¼	3,120,392	53,569	385,608	153,468	185,218
5. Western..........	156	9,963,709	63,870	590,743	778,770	598,059
6. Georgia..........	213	3,930,057	16,766	244,029	484,894	302,437
7. Boston and Maine and branches.....	83	4,021,606	48,453	387,681	204,761	289,478
8. Baltimore & Ohio.	186	10,096,571	54,283	355,561	993,661	695,919

ECONOMICAL MANAGEMENT.

A number of the New England lines, as well as railways in other sections of the country, were then managed very much as successful short street railways are managed now, in a very economical spirit. Much stress was laid upon low salaries. An indication of the system pursued on many lines is furnished by the following summary, published by a New Hampshire newspaper, of the contents of the annual report of the Concord Railroad for 1851: "The report filled 81 pages, and contained a list of all the tools owned by the road, of all the furniture in the stations on its line, and every other article, however small, that went to make up its assets; and besides these, a complete roll of all the employés of the road, from the superintendent down to the wood-sawyers, with the wages paid to each. Isaac Spalding was president, with a salary of $1,000. The Hon. N. G. Upham was superintendent, and got for his services $2,000 a year. The chief clerk got $800, and the assistant, $340, the latter being Henry McFarland, now treasurer of the Union Pacific, with a salary of $5,000. George Clough was a passenger conductor, and got $50 a month, which was the pay of the station agent at Nashua. Engineers on passenger trains had $2.25 per day, and those on freight trains, $2; brakemen and firemen, $1.25, and wood-sawyers and section men, $1. The ticket agents at Concord and Manchester had $800 a year, and ex-Governor James A. Weston, who was the road engineer, $1,000. The wood shop at Concord was in charge of the Hon. John Kimball, who had $3.19½ per day, and one of his workmen was his brother, Benjamin A., who got but $6 per week. These last mentioned are now two of the wealthiest men in Concord, and one is a director of the road. At that time the road did but a third as much business as now, but it paid 10 per cent. dividends."

NEW YORK RAILWAYS.

A number of short lines, running parallel with the Erie Canal, which were subsequently combined in the New York Central, were perhaps more profitable during their independent existence than at any subsequent period. Of the Utica and Schenectady, for instance, it is said, that in 1846 its freight business was trifling, but that it was then "doing the most profitable business of any railroad corporation in the country. It was 78 miles in length, and was constructed and put in operation for $1,500,000. In a period of about fourteen years its total receipts were $6,856,046. Its expenditures were $2,637,842, and its excess of earnings over current expenses during that time were $4,218,204, reimbursing the entire cost of the road, and yielding a clear net profit of $2,718,204, over 18½ per cent. per annum."

Nearly all these short lines seem to have done remarkably well, during a considerable portion of their independent existence. The following table was published in 1849 as a statement of the length and cost of the railways from Albany to the Falls of Niagara, and net revenue in 1848, as compiled from the official returns made to the State Engineer and Surveyor, January 20th, 1849:—

Name of railroad	Length of road in miles.	Total cost.	Average cost per mile.	Net revenue p. ct. on cost.
Albany and Schenectady.....	16.91	$1,606,196	$94,985	6.2
Utica and Schenectady.......	78.00	3,227,946	41,384	16.4
Syracuse and Utica..........	54.80	1,968,036	37,273	13.1
Auburn and Syracuse........	26.00	1,125,886	43,303	9.1
Auburn and Rochester.......	78.00	2,644,520	33,904	10.0
Tonawanda.................	43.50	974,865	22,410	18.2
Attica and Buffalo..........	31.50	821,313	26,073	10.3
Buffalo and Niagara Falls....	22.00	250,396	11,381	14.2
Total..................	348.71	......	Average...	12.2

The New York and Erie, on the other hand, was much less fortunate in the way of securing an adequate return on capital expended as it was progressing. It was the most ambitious project undertaken by a single company in the entire country, as it contemplated a continuous line more than four hundred miles in length from the outset, with important branches, and a probable extension through Western states, perhaps to the Mississippi. The estimated cost of construction of its main line, from New York city to the lakes, had constantly been increasing, as recognized railway requirements were expanding. The original estimate, made by Hon. Benjamin Wright, who was one of the most distinguished of the early American engineers, and a leading spirit among the New York canal engineers, was deposited in the office of the Secretary of State of New York in January, 1835, after a survey had been made, at the expense and under the authority of that commonwealth.

The length of the proposed road was reported to be 483 miles. A superstructure of iron laid upon timber would cost, according to the estimates, $3,400 per mile, being—

For 483 miles..	$1,642,000
The cost of grading......................................	2,717,518
Contingencies, 10 per cent...............................	271,751
Engineering, 3 per cent..................................	130,791
That is to say, for the whole work....................	$4,762,260

Nothing was allowed under the head of cost of right of way, the inhabitants along the route surveyed preferring unanimously to execute free concessions of so much land as might be requisite.

After receiving the report of Judge Wright, the directors of the New York and Erie Railroad Company deemed it important that the plan of the whole road should be carefully settled under sound advice, and, with the cheerful acquiescence of Judge Wright, they associated with him in consultation Mr. Robinson, chief engineer of several public works in Pennsylvania, and Jonathan Knight, chief engineer of the Baltimore and Ohio Railroad. In September, 1835, these gentlemen presented their joint report, which was published for the information of the stockholders. The estimate for the cost of the whole road, upon the plan as modified in the consultations, stood thus:—

Grading and extra expenses for a tunnel.........................	$2,817,518
Superstructure..	1,857,000
Engineering..	300,000
Engines, cars, and other necessary apparatus...............	500,000
Contingencies..	525,000
Total..	$6,000,000

The expense or cost of the projected road required a net revenue of $360,000 to produce a return of 6 per cent. per annum, and the directors stated that they had deemed it their duty to inspect personally the whole line of the route, and to form for themselves an opinion as to the feasibility and practicability of the proposed work. They announced their belief that the whole enterprise could and would be speedily and successfully accomplished; that it would afford to the individuals who might embark their funds in it all the benefits which had been anticipated by its most ardent supporters.

Shortly after the main line was finished and in operation its reported cost was $26,000,000, which was not far from the average cost per mile of some of the other railways constructed through mountainous districts in which a large number of bridges, viaducts, and expensive grading were required. As population was comparatively limited, and no route of local or through trade and travel had previously existed along the line, the company was destined to share the disappointment which has followed the completion of many other projects that were based on the expectation of realizing from competitive through traffic the remunerative profits that could not reasonably be anticipated from local business.

NEW JERSEY RAILWAYS.

The leading New Jersey roads were, in the fifth decade, regarded as highly successful and productive, principally on account of their possession of a large amount of remunerative passenger traffic.

RAILROADS OF PENNSYLVANIA.

Before 1850 all the railway business of the Pennsylvania Railroad was of comparatively small magnitude. The Philadelphia, Wilmington and Baltimore had not yet become specially profitable. The operations of the Philadelphia and Reading for the year ending November 30th, 1850, which road at that time carried more freight in proportion to mileage, and more tons of freight than any other railroad in the country, were reported to be as follows: Gross receipts, $2,363,958, of which $2,071,731 were derived from coal; $125,822 from merchandise; and $166,405 from passengers, mail, and miscellaneous sources. Total expenses, $1,080,323, of which $792,024 were transportation expenses; $154,780 roadway expenses; and $133,519 shipping expenses, rents, taxes, profit and loss, &c. Tonnage, 1,351,502 coal (2,240 pounds); 63,625 tons merchandise (2,000 pounds); 157,450 tons company's materials (2,000 pounds). The total number of passengers was 92,726, equal to 46,041 through passengers. The cost of transportation was for coal 44.01 cents per ton; for merchandise 67.30 cents per ton; and for through passengers 73.40 cents. The number of locomotives was 92; number of miles run 1,233,144; average weight of coal trains 372 tons; cost of repairs $76,245; number of freight and coal cars 5,117; cost of repairs $163,780; number of passenger cars 28; cost of repairs $7,880; wood used (presumably chiefly as fuel for locomotives) 53,997 cords; coal used 4,335 tons; oil used 42,845 gallons; main track open 95 miles; double track 95 miles.

The Philadelphia and Reading was peculiar, not only in being the great freight carrier of the country, but in having cost more than $17,000,000, or nearly $180,000 per mile, including a much more extensive equipment, in proportion to length, than any other American road then possessed. In a report made on January 14th, 1850, by David A. Neal, he refers to the unusually large expenditure for construction, which he stated to be more than sixteen millions of dollars for less than a hundred miles of railroad, and he stated that it is to be regretted that much of the money was spent in procuring the capital needed, and in paying extravagant rates of interest for financial accommodations. He says: "The great drain, it is hoped, has ceased. Enormous rates of interest, bonds sold at half their nominal value, commissions, brokerages, and similar charges, ought to be no more heard of forever in the annals of the Reading railroad."

At the same time, the road was then doing a profitable business, and its capacity for conducting and commanding a large freight traffic was then unequaled in this country.

The most successful of the southern lines were those located in Georgia, but some of the roads in other states yielded fair returns.

THE BALTIMORE AND OHIO

report for the year ending September 30th, 1850, gives a tabular statement of the financial results of the working of the company for twenty-one years, from 1830 to 1850, inclusive. The aggregate net receipts of the operations of all these years was $4,919,992. Dividends had been declared during nine years. Their aggregate amount was $1,089,138. The surplus reported to be reconverted was $3,830,854—this sum representing the difference between aggregate amount of dividends and the aggregate amount of net receipts. The largest business reported was that of 1850, which included the carriage of 3,689,662 passengers (nearly half of whom were carried on the Washington branch), the carriage of 477,555 tons of freight, and total receipts from passengers and tonnage of $1,343,805—438,375 of which was derived from passengers and mails, and $905,430 from tonnage. The expenses of the year were $609,589, and net receipts $734,216. No dividend was declared. The surplus of this and previous years was presumably devoted to construction.

WESTERN RAILWAYS.

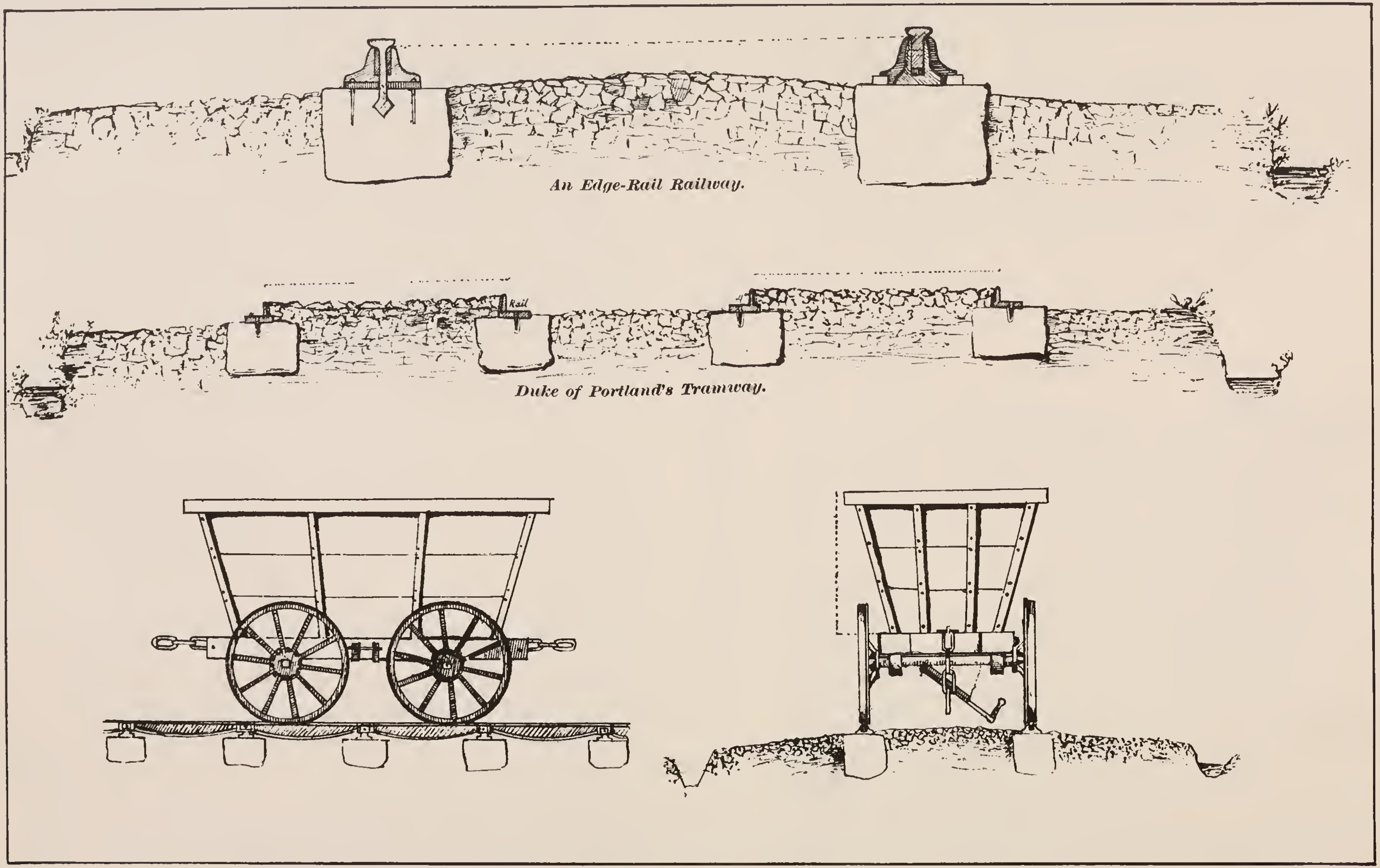
The following statement of operations of western railroads was made in 1852:—

	Total earnings, as per last report.	Net earnings.	Per mile.
Cleveland and Columbus*.....	$341,680 96	$239,969 27	$1,710
Little Miami.................	487,815 09	297,457 57	3,541
Columbus and Xenia	211,631 37	150,055 58	2,778
Michigan Central.............	1,100,013 00	461,364 80	2,116
Madison and Indianapolis.....	386,078 00	185,080 60	2,378

* For six months only.

Of the Little Miami it was reported that in 1848 its net earnings were $146,072.48, or 10 per cent. of the capital stock. Of the Madison and Indianapolis it was reported in 1849 that it was earning dividends of 14 per cent. per annum, and that its stock was much above par.

A graphic description of the trials and difficulties which the projectors of the first successful railway running west from Chicago encountered is furnished in an address delivered in Chicago a few years ago by Augustus W. Wright. It was to run from Chicago to Galena, and a vast amount of effort, in the way of soliciting stock subscriptions, borrowing money from friends of the directors in seaboard states, and the pledging of their private credit, was necessary to insure construction. The road was finished to Elgin, and proved to be unexpectedly profitable. Mr. Wright's account concludes with the following statement: "The first grade peg for the track was set by Mr. George W. Waite, assistant engineer, in June, 1848, near the corner of Kinzie and Halsted streets, the then western city limits, the city officials refusing permission to enter the city. Leave was, however, granted to lay a temporary track from that point to the North Branch of the Chicago river, in order to transport the locomotive to the ground. This, the first locomotive in Chicago, was the 'Pioneer.' It had two driving-wheels, weighed about ten tons, and, I think, was manufactured by Baldwin. Of course, it came by water. It was purchased second-hand from the Rochester and Tonawanda Railroad, and was unloaded upon a Sunday, Mr. Waite, Mr. Lake, Mr. Redmond Prindiville, and Mr. John Ebert assisting. The latter gentleman was the locomotive engineer, and subsequently the well-known master mechanic of the company. Mr. George C. Morgan, the prominent hydraulic engineer, was Mr. Waite's rodman. It was the intention of the company to use first-class T-rails, but their poverty prevented, and Messrs. Raymond and Turner purchased at Buffalo a lot of second-hand strap-rails that had been taken up from an eastern road, on the personal credit of the board of directors, and six second-hand freight cars from the Michigan Central Railroad, also a second-hand locomotive, the Pioneer. This engine, with the six freight cars in tow, plied backwards and forwards between the end of the track and Chicago. To the former point the farmers brought their grain in quantity. An accurate account of the expenses was kept for thirty days, which demonstrated the fact that the road was earning above operating expenses at the rate of 10 per cent. per annum. Mr. Raymond thereupon returned east with these figures and facts, and called upon Mr. Dexter with the request for $30,000. Mr. Dexter was president of the Whitestown Bank. Finding the bank's money was all out in circulation, he issued to Mr. Raymond, in sums of $25 and $50, the sum of $30,000 of certificates of deposit, with which, and stock collections, John B. Turner, managing director, by careful and economical management, extended the road to Elgin. Having reached that point in 1850, the road paid handsomely, successively, half-yearly, 10, 12, 15, and 16 per cent. dividends, and the business proved so large that it could not manufacture cars fast enough,



ENGLISH RAILWAYS AND FREIGHT CARS, AS ILLUSTRATED IN STRICKLAND'S REPORT, 1826.

and had to purchase or borrow a considerable number from the Michigan Central."

LAND-GRANT RAILWAYS.

While most of the states were seeking rather to disentangle themselves from railway operations or alliances than to increase such connections the United States government was preparing to make its first serious ventures in the way of granting public lands to promote railway construction. Donations of such lands had frequently been previously made to promote various objects, including several kinds of internal improvements. But the decisive initial movements to aid railways were reserved for the period under discussion. In a paper read by W. K. Ackerman, formerly president of the Illinois Central, before the Chicago Historical Society, in 1883, he said:—

"As far back as 1848 senator Douglas had introduced a bill in the United States senate granting alternate sections of the public land to the state of Illinois to aid in the construction of a railroad from Cairo to Galena with a branch to Chicago. The original project contemplated but one line, that from Cairo to Galena, but senator Douglas included in his bill a road connecting with the lakes, thus securing for it friends in the Northeastern and Middle states who did not favor a proposition having for its natural tendency the diversion of trade from the Upper Mississippi toward New Orleans alone. The bill was reported from the Senate committee on public lands, of which the Hon. Sidney Breese, of Illinois, was chairman. It was subsequently taken up and early in May was passed by the Senate. The representatives in the House from Illinois all gave it their cordial support, but toward the close of the session it was laid on the table by a small majority. At the next session (1848–49) Mr. Douglas introduced his bill in the Senate again, but before any action was had in that body the Illinois representatives in the House had succeeded in having the bill of the last session restored to its place on the calendar; but Congress adjourned without any further action on the bill by the House. In December, 1849, Mr. Douglas with his colleague, General Shields (who had succeeded Mr. Breese), and the Illinois delegation in the House, matured a bill looking to the construction of the Illinois Central road and its Chicago branch. That bill, which all the Illinois members had a voice in framing, was introduced in the Senate by Mr. Douglas in January, 1850, and while this bill was pending the Cairo City and Canal Company induced the legislature of Illinois to pass a measure ceding to that company all lands that might at any time be granted by Congress to the state to aid in the construction of the Illinois Central Railroad. Senator Douglas was unwilling that the grant should pass to a private corporation direct, and finally induced D. B. Holbrook, the president of the Cairo City and Canal Company to release to the state of Illinois all the rights of that company, which he did, executing on the 24th of December, 1849, on behalf of his company as president, a full release and surrender to the state of Illinois of what was known as the Holbrook charter, with all the rights and privileges therein contained; in accordance with which the legislature, on the 17th of December, 1851, passed an act accepting this release, and to make assurance doubly sure, repealed all the acts which they had before granted to this company—(16th January, 1836, 6th March, 1843, and 10th February, 1849.) The same act accepted the act of Congress of 20th September, 1850, granting the lands to the state of Illinois to aid in the construction of a railroad from Chicago to Mobile. The bill making a grant of lands to the states of Illinois, Mississippi, and Alabama, passed the United States senate on the 2d of May, 1850, by a vote of 26 to 14, and was passed in the House on the 20th of September, 1850. Mobile was inserted as the objective point by Mr. Childs, who was at that time largely interested in the Mobile and Ohio Railroad Company."

EFFECT AND EXTENT OF REDUCTIONS OF COST OF OVERLAND TRANSPORTATION.

On the question of transportation between various inland points the entire development of many sections has hinged. Before the extensive construction of railroads it was impossible to advantageously prosecute numerous agricultural and mining interests at points distant from water routes on account of the great expense of hauling them overland. Andrews' Report on the Colonial and Lake Trade, written in 1852, and published as an official document by the United States government in 1854, says:—

"It is well known that upon the ordinary highways the economical limit to transportation is confined within a comparatively few miles, depending, of course, upon the *kind* of freight and character of the roads. Upon the average of such ways the cost of transportation is not far from 15 cents per ton per mile, which may be considered a sufficiently correct estimate for the whole country. Estimating at the same time the value of wheat at $1.50 per bushel, and corn at 75 cents, and that 33 bushels of each are equal to a ton, the value of the former would be equal to its cost of transportation for 330 miles, and the latter 165 miles. At these respective distances from market neither of the above articles would have any commercial value, with only a common earth road to market.

But we find that we can move property upon railroads at the rate of 1.5 cent per ton per mile, or for one-tenth the cost upon the ordinary road. These works, therefore, extend the economic limit of the cost of transportation of the above articles to 3,300 and 1,650 miles respectively. At the limit of the economical movement of these articles upon the *common* highway, by the use of railroads, wheat would be worth $44.50 and corn $22.27 per ton, which sums respectively would represent the actual increase in value created by the interposition of such a work.

The following table will show the amount saved per ton by transportation by railroad over the ordinary highways of the country:—

Statement showing the value of a ton of wheat, and one of corn, at given points from market, as offected by cost of transportation by railroad, and over the ordinary road:—

	Transported by railroad (at 1½ cts. per ton per mile).		Transported by ordinary highway.	
	Wheat.	Corn.	Wheat.	Corn.
Value at market	$49 50	$24 75	$49 50	$24 75
10 miles from market	49 35	24 60	48 00	23 25
20 " "	49 20	24 45	46 50	21 75
30 " "	49 05	24 30	45 00	20 25
40 " "	48 90	24 15	43 50	18 75
50 " "	48 75	24 00	42 00	17 25
60 " "	48 60	23 85	40 50	15 75
70 " "	48 45	23 70	39 00	14 25
80 " "	48 30	23 55	37 50	12 75
90 " "	48 15	23 40	36 00	11 25
100 " "	48 00	23 25	34 50	9 75
110 " "	47 85	23 10	33 00	8 25
120 " "	47 70	22 95	31 50	6 75
130 " "	47 55	22 80	30 00	5 25
140 " "	47 40	22 65	28 50	3 75
150 " "	47 25	22 50	27 00	2 25
160 " "	47 10	22 35	25 50	75
170 " "	46 95	22 20	24 00	....
180 " "	46 80	22 05	22 50	....
190 " "	46 65	21 90	21 00	....
200 " "	46 50	21 75	19 50	....
210 " "	46 35	21 60	18 00	....
220 " "	46 20	21 45	16 50	....
230 " "	46 05	21 30	15 00	....
240 " "	45 90	21 15	13 50	....
250 " "	45 75	21 00	12 00	....
260 " "	45 60	20 85	10 50	....
270 " "	45 45	20 70	9 00	....
280 " "	40 30	20 55	7 50	....
290 " "	45 15	20 40	6 00	....
300 " "	45 00	20 25	4 50	....
310 " "	44 85	20 10	3 00	....
320 " "	44 70	19 95	1 50	....
330 " "	44 55	19 80	....	....

HOW RAILROADS INCREASED THE VALUE OF LANDS.

"The value of lands is affected by railroads in the same ratio as their *products*. For instance, lands lying upon a navigable water-course, or in the immediate vicinity of a market, may be worth, for the culture of wheat, $100. Let the average crop be estimated at 22 bushels to the acre, valued at $33, and the cost of cultivation at $15. This would leave $18 per acre as the net profit. This quantity of wheat (two-thirds of a ton) could be transported 330 miles at a cost of 10 cents per mile, or $3.30, which would leave $14.70 as the net profit of land at that distance from a market, when connected with it by a railroad. The value of the land, therefore, admitting the quality to be the same in both cases, would bear the same ratio to the assumed value of $100 as the value of its products, $14.70, does to $18, or $82 per acre, which is an actual creation of value to that amount, assuming the correctness of the premises. The same calculation may, of course, be applied with equal force to any other kind and species of property. The illustration given establishes a principle entirely correct in itself, but, of course, liable to be modified to meet the facts of each case. Vast bodies of the finest land in the United States, *and lying within two hundred miles of navigable water-courses, are unsaleable*, and nearly, if not quite, valueless for the culture of wheat or corn for exportation, from the cost of transportation, which in many instances far exceeds the estimate in the above table. Under such circumstances, products are often fed out to live stock, and converted into higher values, which will bear transportation when the former will not. In this manner lands are turned into account, where their immediate products would otherwise be valueless. But in such cases the profit per acre is often very small; as in districts best adapted to the culture of corn it is considered more profitable to sell it for 25 cents per bushel than to feed it out to animals. It will be seen that at this price its value is eaten up by the cost of transportation of 165 miles."

There are no enduring phases of railway development of more real consequence to the entire body of the American people than those which hinge upon the vital improvement made in the possible productive capacity of all sections of the country not located near available water routes, by the cheapening of the cost of overland transportation. Notwithstanding all that has been done or may be done to reduce the cost of movements on natural or artificial water channels, there are an immense number of great interests which would languish and perish if overland freight charges were not reduced to a standard far below that attainable on ordinary roads, turnpikes, or the early railroads.

Near the end of the fifth decade very important steps for the commencement of the great work of cheapening overland freight charges were made, but the general range of charges continued to be high, and the extent of positive advances in lowering fares and tariffs is indicated by the following statements:—

ESTIMATED AND ACTUAL CHARGES FOR FREIGHT AND PASSENGER RAIL MOVEMENTS IN THE FIFTH DECADE.

General Herman Haupt, in testimony before Senate committee on transportation routes to the seaboard, October 22d, 1873, said that "it was a subject of animated discussion twenty-five years ago (1848) in the Pennsylvania Railroad board whether a low rate should be established to admit of the transportation of coal, and the position taken was that coal and such articles could not be transported on railroads; that the canals, such as we had then in Pennsylvania, would answer very well for the transportation of such articles, but railroads must be used exclusively for passengers and light freights; that anything carried at a less cost than two cents a ton a mile would be at a positive loss; *the cost then exceeded two cents a ton a mile*, and at that time there was a tonnage of only a hundred thousand tons over the Pennsylvania Railroad. In order to demonstrate the practicability of carrying coal, I made an analysis of the business of the preceding year, separating those items which would be increased by an increased business from the general and constant expenses, which were independent of the volume of tonnages. After making a careful analysis, I succeeded in demonstrating that the actual cost of the transportation of coal over the Pennsylvania Railroad would not exceed about seven or eight mills a ton a mile, while it would bear a price for freight of a cent and a quarter. Subsequently the Pennsylvania Railroad Company engaged in the coal transportation, and now (1873) their whole average charge for transportation of all classes of freight is only one cent and four mills for all the business of the road, which exceeds 8,000,000 tons per annum, The actual cost of service with a smaller volume of tonnage then *exceeded two cents a ton a mile*, as previously stated."

In a series of articles, published about 1850, Mr. Henry C. Carey said: "From New York to New Haven, a distance of 75 miles, travelers pay $1.50, or two cents per mile. Traveling west, the charge on the Erie road is $1.50 for 87 miles. . . . Twelve years since the fare of a passenger from Chicago, Illinois, 1,500 miles, was $74.50. It is now but $17. . . . Twelve years since the cost of transporting a bushel of wheat from Chicago to New York was so great as effectually to keep the grain of that country out of the market. Now a bushel of wheat is transported the whole distance, 1,500 miles, for 27 cents. A barrel of flour can be transported from Chicago to New York for 80 cents."

The freight tariff established by the Michigan Central Railroad in August, 1848, on flour, wheat, and merchandise, was as follows:—

	Between Detroit and Dexter, 49 miles.	Between Detroit and Kalamazoo. 146 miles.
On 10 barrels of flour (nearly a ton)	$2 30	$6 00
On one ton of wheat (2,240 lbs.)	2 24	6 04
On one ton of merchandise	5 37	11 64

Progress of Nations says: "Though these prices seem high, yet they were much higher during the previous years."

A majority report from a committee on inland navigation and internal improvement, made to the Pennsylvania legislature by Mr. Burnside, in March, 1845, said:—

On our public works dry goods are carried from Philadelphia to Pittsburgh for:—

	Per 100 lbs.
About	$1 37½
Groceries	75
Produce from Pittsburgh to Philadelphia	62½

Flour from 70 to 80 cents per barrel.

By Wilmington railroad the prices from Philadelphia to Baltimore are, for:—

	Per 100 lbs.
Dry goods	12½
Groceries	10

From Baltimore to Cumberland, 180 miles:—

	Per 100 lbs.
Dry goods	35
Groceries	25
Making on dry goods to Cumberland	47½
On groceries to Cumberland	35

A report made in 1849 by the engineer of the St. Lawrence and Atlantic Railroad, which was the line by which the Grand Trunk, of Canada, gained a connection with Portland, Maine, contains the following statement of the cost of transporting a barrel of flour in 1848 over the routes named:—

Erie Canal Route.

	Cents.
From Cleveland to Buffalo (lake)	12
From Buffalo to Albany (canal)	70
From Albany to Boston (rail)	30
Total to Boston	112
If carried thence to Portland	10
Total to Portland	122

St. Lawrence Route.

	Cents.
From Cleveland to Montreal	40
From Montreal to Portland	45
Total to Portland	85
If carried thence to Boston	10
Total to Boston	95

The rail transportation was 200 miles by the Erie Canal route, and 275 miles by the St. Lawrence route.

In reference to anthracite coal transportation from the Schuylkill region, it was reported in January, 1850, that there were two outlets, in the Reading railroad and the Schuylkill

Navigation. By the former the freight and tolls at tide-water at Richmond averaged, in 1849, about 30 cents per ton more than by the latter to the wharves on the Schuylkill. The mines in the Schuylkill valley can deliver coal at Mount Carbon at $1.25 to $1.50 per ton; freight per railroad, $1.50 to $1.80; its cost at tide-water, from $2.75 to $3.30.

PASSENGER FARES.

In a publication made by Mr. Henry C. Carey in January, 1848, he stated that the following list embraced every railroad in the Union north of Baltimore and east of Ohio, except Camden and Amboy lines, viz.:—

Name.	Length in miles.	Through fare.	Per mile, cents.
Eastern	105	$3 00	2.85
Boston and Maine	110	3 00	2.72
Boston and Lowell	26	65	2.5
Boston and Worcester	44	1 25	2 8
Boston and Providence	42	1 25	2.97
Fitchburg	71	1 75	2.46
Fall River	52	1 35	2.54
Old Colony	37½	1 00	2 66
Western	156	3 75	2.77
Nashua and Lowell	15	40	2 66
Concord	34	80	2 35
Norwich and Worcester	60	1 50	2.5
New Haven and Springfield	62	1 87	3.00
Bridgeport	98	2 00	2.04
New York and Harlem	53	1 00	1.88
New York and Erie	87	1 50	1.72
Long Island	95	2 00	2.1
New York and New Brunswick	33	75	2.27
Reading	92	3 00	3.26
Philadelphia and Baltimore	97	3 00	3 01
Westchester and Columbia	32	75	2.34
Philadelphia, Lancaster and Harrisburg	107	4 00	3.73
Philadelphia, Germantown and Norristown	17	40	2.38
Harrisburg and Chambersburg	56	2 12	3.78
Albany and Schenectady	17	50	2.94
Greenbush and Troy	6	20	3 33
Troy and Schenectady	20½	50	2.43
Utica and Schenectady	78	3 00	3.84
Utica and Syracuse	53	2 00	3.77
Syracuse and Auburn	26	1 00	3.84
Auburn and Rochester	77	3 00	3.89
Rochester and Athens	44	1 56	3.54
Attica and Buffalo	31½	94	2.98
Buffalo and Niagara Falls	22	75	3.44
Lockport and Niagara Falls	24	75	3.12

The average fare on all these lines was, according to this statement, 2.85 cents per mile.

A pamphlet published in Philadelphia in 1850 gave the following table as a statement of the fare and distances on the principal railroads in the United States:—

Names and termini.	Through fare.	Miles.
Albany and Schenectady	$0 50	16
Attica and Buffalo	0 94	32
Auburn and Rochester	3 00	78
Auburn and Syracuse	1 00	26
Baltimore and Susquehanna	2 13	65
Baltimore and Ohio	7 00	179
Baltimore and Washington	1 60	40
Boston and Lowell	0 65	27½
Boston and Maine [to S. Berwick]	1 00	82½
Boston and Old Colony [to Plymouth]	1 00	44½
Boston and Providence	1 25	47½
Boston and Worcester	1 25	58½
Camden and Amboy	2 75	61
Central [Macon to Savannah]	7 00	191
Columbia [branch of S. C.]	3 38	68
Eastern [Lowell and branches]	1 48	58
Fitchburg [to Boston]	1 25	51¾
Gaston and Raleigh, N. C	4 00	87
Georgia [Augusta to Atlanta]	7 00	171
Housatonic [Conn. and Mass.]	2 00	75
Little Miami	2 00	84
Long Island and branches	2 00	98¼
Macon and Western [to Atlanta]	4 00	101
Mad River and Lake Erie	3 25	102
Madison and Indianapolis	3 00	86
Michigan Central	4 40	146
Michigan Southern	2 00	70
New York and Erie [to Port Jervis]	1 50	74
New York and Harlem	1 00	53
Norwich and Worcester	1 50	59
Northern [Concord to Lebanon]	2 15	65
Philadelphia and Baltimore	3 00	97
Philadelphia and Reading	3 50	92
South Carolina	6 75	136
Stonington [to Providence]	1 50	47¾
Syracuse and Utica	2 00	53
Tonawanda	1 56	43½
Utica and Schenectady	3 00	78
Vicksburg and Jackson	3 00	47
Washington and Richmond	3 00	76
Western [Albany to Worcester]	4 25	156
Wilmington and Weldon	4 00	161½

COST OF TRANSPORTATION ON THE NEW JERSEY LINES.

An address of the directors of the Delaware and Raritan Canal, and Camden and Amboy Railroad companies to the people of New Jersey, dated June 11th, 1848, has the following tables appended:—

Statement of the Business of the Camden and Amboy Railroad and its Branches, and the Philadelphia and Trenton Railroad, for the Month of May, 1848.

	Number of passengers.	Miles carried.	Number of passengers carried one mile.	Total amount received for fares.	Amount received for each passenger per mile, cents.
Way passengers:—					
Way travel on the Philadelphia and Trenton Railroad	8,077	..	222,134	$4,268 18	1.9¼
Way travel from Philadelphia to New Brunswick and intermediate places on the branch and Trenton and Philadelphia roads, with the 9 and 4½ o'clock lines	1,861½	..	67,443	2,818 17	4.1¾
Trenton and New York accommodation line from Trenton to Jersey City	992	58 8/10	58,329	1,372 17	2.3½
	10,930½	..	347,906	$8,458 52	2.4¼
Camden and Amboy way lines	23,994	..	493,698	6.189 81	1.2½
Aggregate of way business on Camden and Amboy and Philadelphia and Trenton railroads	34,924½	..	841,604	$14,648 33	1.7½
Through passengers:—					
Through Camden and Amboy 6 and 1 o'clock lines	8,465	..	761,850	$25,531 25	3.0¾
Through 9 and 4½ o'clock lines via New Brunswick, New York, and Philadelphia ($4)	9,070¼	90	816,345	36,2?2 00	4.4½
Through 9 and 4½ o'clock second-class lines, via New Brunswick, New York, and Philadelphia ($3)	2,118	..	190,620	6,364 00	3.3⅓

From the above it appears that way passengers were carried at the average charge per mile of 1 cent 7½ mills, and that passengers were carried through at the average charge per mile of 3 cents 5¼ mills, or an average charge on both of 2 cents 6½ mills.

Statement of the Cost of Transportation per mile on the Canal and Railroad for May, 1848, between New York and Philadelphia.

On the canal, 84,488 tons carried 110 miles = 9,293,680 for one mile, $100,984 freight; on the railroad, 1,983 tons carried 90 miles = 178,470 for one mile, $21,115 freight; total canal and railroad, 86,471 tons carried 200 miles = 9,472,150 for one mile, $122,099 freight, or an average freight on both works of 1 cent and 29-hundredths of a cent per mile.

[NOTE.—It will be seen that the cheap movements were all made on the canal, and that the rate per ton per mile on the railroad was nearly 11.9 cents per ton per mile.]

Williams' Traveler's and Tourist's Guide, published in 1851, gives the following table and preface showing—

THE DISTANCES, FARES, &C., FROM BOSTON TO MANY OF THE MOST IMPORTANT PLACES IN THE UNION.

The following will show at a glance the *distance, expense,* and *time* occupied, in traveling from Boston to the most prominent points in the Union. Allowance, however, must be made in the rate of fares when traveling in steamboats, upon lakes, or rivers, as these modes of conveyance are subject to more or less competition, in which case the fares vary. Those given, however, are as accurate as can be obtained under the circumstances, and will, no doubt, be found near enough to make up a general estimate of expenses. Similar information will be found at the end of many of the routes, which will be both useful and convenient. The *time* given is that which is actually occupied in passing from one point to another; the detentions between each route are not taken into consideration, as these the traveler must determine for himself. The *distances* are given by the shortest route:—

	Miles.	Time in hours.	Fares.
From Boston to Albany	200	10	$5 00
From Boston to Buffalo	525	28	11 60
From Boston to Cincinnati via Cleveland	963	48	20 00
From Boston to Detroit	855	43	16 00
From Boston to Chicago	1,073	54	23 00
From Boston to St. Paul, Min. Ter	1,550	95	35 00
From Boston to St. Louis via Chicago and Springfield	1,400	75	33 00
From Boston to New Orleans via Chicago and Springfield	2,601	101	43 00
From Boston to New York	236	10	4 00
From Boston to Philadelphia	423	15	7 00
From Boston to Baltimore	520	21	10 00
From Boston to Washington	560	24	11 80
From Boston to Charleston, S. C.	1,018	66	24 00
From Boston to Savannah, Ga	1,143	76	29 00
From Boston to Montgomery, Ala	1,535	90	40 00
From Boston to Mobile, Ala	1,732	130	48 00
From Boston to New Orleans	1,898	142	53 00
From Boston to Pittsburgh via Philadelphia	697	33	17 00
From Boston to Wheeling via Baltimore	800	40	20 00
From Boston to Cincinnati via Philadelphia, Pittsburgh, and the Ohio river	1,174	73	18 00
From Boston to New Orleans via Pittsburgh and the Ohio and Mississippi rivers	2,722	223	23 00
From Boston to St. Louis via Pittsburgh and the Ohio and Mississippi rivers	1,871	140	28 00
From Boston to Montreal, Can	337	17	8 00
From Boston to Nashville, Tenn., via Cleveland, Cincinnati and Cumberland Railroad	1,638	130	30 00

AVERAGE FREIGHT AND PASSENGER CHARGES ON ALL AMERICAN RAILROADS IN 1848.

General Statement, showing the Averages of Fare per mile for First- and Second-class and Way Passage, and First- and Second-class Freight per ton per mile (omitting the Camden and Amboy and Union Transportation Railroads, and the Bordentown and Trenton Branch Railroad), taken from Doggett's Railroad Guide for 1848.

States.	No. of railroads and branches.	Total length, miles.	1st class, average fare per mile in cents and 100 pounds.	2d class, average per mile in cents and hundredths of a cent	Way passage per mile, average in cents.	Whole average of 1st and 2d class and way fares.	1st class freight per ton per mile, average in cents.	2d class freight per ton per mile, average in cents.
Maine	3	226¾	2.82	2.50	2.57	2.63	5.68	3.38
New Hampsh'e.	2	99	3.00	3.00	2.62	2.87½	5 25	5.00
Vermont	1	33	3.00	3.00	3.00	3.00	4.00	4.00
Massachusetts	36	1,929½	2.43	1.66	2.71	2.27	5.47	4.51
Rhode Island	2	91¼	3.00	2.00	3.16	2.72	6.37	4 39
Connecticut	4	253¾	2 50	1.75	2.20	2.15	5.75	3.50
New York	20	798	3.17	1 50	3.75	2.81⅔	9.04	5.79
New Jersey	4	155	4.00	3.33	3.54	3.62⅓	13 57	11.66
Pennsylvania	9	355	3.60	3.26	3 60	3.48⅔	6.75	5.35
Maryland	9	661	3.45	3.45	3.58	3.49⅓	4.56	3.12
Virginia	6	264¾	4 74	2.38	4.72	3 91⅔	10.44	4.69
North Carolina.	2	248	4.23	4.23	4 00	4.15⅓	9.83	6.37
South Carolina.	2	204	5.00	5.00	5.00	5 00	10.75	5.50
Georgia	5	602	4.14	4.14	4.70	4.32⅔	9.33	4.78
Kentucky	1	28	4.46	4.46	4.46	4 46	9.00	9.00
Mississippi	2	70	5.35	5.35	6.00	5 56⅔	24.30	17.30
Alabama	1	67	4.60	4.50	5.50	4.83⅓	16 33	8.00
Ohio	4	307	2.77	2.77	2.66	2.73⅓	6.60	4.62
Indiana	1	86	3.00	3.00	3.00	3.00	8.00	5.81
Michigan	3	241	3.00	3.00	3.32	3 10⅓	8.44	6.50
20 states, totals.	117	6,720	72.16	64.28	74.09	70.19	179.46	120.30
Averages	..	....	3.60	3.21	3.70	3.51	8.97	6.16

The average cost of all freight movements, including first and second class, on all lines given above, was 7.56 cents per ton per mile.

PHYSICAL PROGRESS DURING THE FIFTH DECADE.

ESTABLISHMENT OF AMERICAN RAIL WORKS.

DURING the fifth decade a number of mechanical, engineering, and manufacturing advances were made in the United States which greatly facilitated railway operations. In the long list of inventions and improvements pertaining to this era few, if any, have left a more permanent impress than those resulting from the establishment, in this country, of works which could manufacture iron rails of various patterns. The first American effort to produce rails of any kind is probably that mentioned by Mr. Solomon W. Roberts, and which was made by the Lehigh Coal and Navigation Company. It undertook, in the summer of 1826, to cast in its foundry at Mauch Chunk rails four feet long, to be used on its projected pioneer coal railway, but the work was abandoned on account of its being too expensive.

Mr. James M. Swank, general agent of the American Iron and Steel Association, furnished for the census report of 1880 interesting data relating to the subsequent progress of early American rail-making, from which we compile the following statements: Cast-iron rails were made in this country in small quantities during the early years of our railway history, notwithstanding the unfavorable experiment at Mauch Chunk. In 1841 a series of tests were made at Pottsville with rails for mine roads cast in a foundry from pig iron made at the Pottsville furnace of William Lyman. These rails were six feet long, and were of various weights. One of the rails tested was intended to sustain locomotives. Notwithstanding these experiments, Mr. Swank states that "many years elapsed after the first railroad was built in this country before any other than flat-iron rails were made in American rolling mills," and that "early in 1844 there were still no facilities in this country for the manufacture of heavy iron rails to supply the wants of the 4,185 miles of American railroad which existed at the beginning of that year, and of a few hundred additional miles which were then projected. . . . On the 24th of April, 1844, the Hon. Edward Joy Morris, of Pennsylvania, declared that 'not a ton of T-rail had been made in this country.' He might have included all other heavy patterns.

"In 1844 the manufacture of heavy iron rails in this country was commenced at the Mount Savage rolling mill, in Allegheny county, Maryland, erected in 1843 especially to roll these rails. The first rail rolled at the Mount Savage rolling mill, and in honor of which the Franklin Institute of Philadelphia, struck a silver medal, was a U-rail, known in Wales as the Evans patent, of the Dowlais Iron Works, at Merthyr Tydvil. It was intended to be laid on a modern longitudinal sill, and was fastened to it by an iron wedge keying under the sill, thus dispensing with outside fastenings. This rail weighed 42 pounds to the yard. About 500 tons of rails of this pattern were laid in 1844 on a part of the road then being built between Mount Savage and Cumberland, a distance of 9 miles. Soon afterwards rails weighing 52 pounds to the yard were rolled at the Mount Savage rolling mill for the road leading from Fall River to Boston.

"The Montour rolling mill, at Danville, Pennsylvania, was built in 1845 expressly to roll rails, and here were rolled, in October of that year, the first T-rails made in the United States. The first T-rail rolls made in this country were made for the Montour Iron Company by Howard & Snyder, proprietors of the Colliery Iron Works, at Pottsville, the work being done at their establishment at Danville. The Boston Iron Works were started in January, 1824, to manufacture cut nails, hoops, and tack plates, but they subsequently rolled rails, and on the 6th of May, 1846, they rolled the first T-rails in Massachusetts, Ralph Crocker being superintendent. In 1845 the rolling mill of Cooper & Hewitt was built at Trenton, New Jersey, to roll heavy rails, and on the 19th of June, 1846, their first T-rail was rolled. About the 1st of September, 1846, the New England Iron Company, at Providence, Rhode Island, commenced to roll T-rails. The first lot of these rails rolled by that company was delivered to the Providence and Worcester Railroad on September 11th, 1846. T-rails were rolled in November, 1846, at Phœnixville, Pennsylvania; in the fall of the same year at the Great Western Iron Works, at Brady's Bend, Pennsylvania, and at the Lackawaxen Iron Works, at Scranton, Pennsylvania; early in 1847, at the Bay State rolling mill, in Massachusetts, then owned by the Massachusetts Iron Company; in January, 1848, at the Rough and Ready rolling mill, at Danville, Pennsylvania, and in the same year at Safe Harbor, Pennsylvania. All of the T-rails made at the mills above mentioned were rolled with a base or flange similar to that of the present T-rail. Some of them did not differ greatly from the H-rail, and, when laid, rested, like it, in a chair. Indeed, the H-rail was sometimes called the T-rail. A few other mills rolled heavy rails before 1850, but at the beginning of that year, owing to foreign competition, only two out of fifteen rail mills in the country were in operation. . . . It seems strange that the T-rail should not have become generally popular until after 1845."

UTILITY OF AMERICAN RAIL MILLS.

Many direct or incidental benefits were derived from the establishment of rail works in this country. Frequently native rails could be obtained at cheaper rates than those prevailing for imported rails, and there were periods when the existence of rail works near the lines of some roads in process of construction was of vital consequence. An illustration of this fact is furnished by an episode in the history of the construction of the Erie. After a protracted struggle with pecuniary and engineering difficulties, the state of New York, in 1845, anxious to secure the completion of the road, again came to its relief. An act was passed by which the New York and Erie Railroad Company were relieved of the claim of the state against them for the loan of $3,000,000, and such substantial aid was extended that the company were enabled to resume the work of construction with a well-filled treasury. The act contained a proviso, however, that the road should be forfeited to the state if, on January 1st, 1849, it was not in readiness for business between Piermont and Binghamton. The company had four years in which to complete 137 miles of road. It is stated that in 1846 the Scranton Brothers secured the capital necessary to commence the manufacture of rails at the Lackawanna Iron Works, largely because they knew that the Erie Railroad Company were obliged to pay $80 a ton for the rails they were importing from England, and that in their straightened circumstances, and in view of the time to which they were limited in finishing the road to Binghamton, they must necessarily obtain iron at cheaper rates and more speedily than the foreign material could be furnished. Subsequent events proved the correctness of this supposition. Difficulties in regard to the location of a route through north-eastern Pennsylvania delayed the progress of construction on the Erie, and one of the results of this delay, as described by a correspondent of the New York World, was that it became "necessary for the iron company to distribute the iron at the different points along the route, the nearest of which was fifty miles from the works. The rails were hauled by teams over the heavy mountain roads of northern Pennsylvania to Narrowsburg, Cochecton, Equinunk, Stockport, Deposit, and Lanesboro. To some of these points roads had to be cut through the dense forest. Over four hundred mules and horses were required, as many as ten span frequently being attached to one wagon. The rails were simultaneously laid east and west from the points named, and five days before the time for the road's completion to Binghamton had expired the last spike was driven. The event was celebrated in Binghamton on the 28th of December, 1848. Benjamin Loder, then president of the company, delivered an address, in the course of which he declared that the energy, enterprise, and promptness of George and Seldon Scranton had saved the New York and Erie Railroad to the company."

So many similar incidents have occurred, that the competition between American and foreign rail makers for the opportunity of supplying the tremendous demand for rails by the various new and old lines of this country has been a factor of very great importance in the railway development of the United States, whether regard be paid to price, quality, promptness of delivery, opportunities for securing variations in weight, shape, and length, or making arrangements by which rail manufacturers could be remunerated for their products.

QUALITY AND LENGTH OF RAILS.

Many discussions have sprung up, at different periods, in regard to the quality of rails. The iron rails imported from England for the very early American railroads were of extraordinary excellence; so good, indeed, that their durability in proportion to weight was only excelled by the better classes of modern steel rails. But as American demands increased, and the custom expanded of paying for English rails with the bonds of new railway companies, which could only be sold at a large discount, and might or might not prove to be sound securities, and as the price of rails declined, complaints became common that some of the imported rails were of very inferior quality, and about or shortly before and after 1850 a number of important purchases of rails of American manufacture were made at prices slightly exceeding the cost of imported rails, on the ground that better guarantees of excellence could thus be secured, and the superiority of quality much more than compensated for the difference in price.

Another interesting phase of early rail manufacture was the gradual increase in the length of the rails laid down. Before 1850 it is probable that very few, if any, rails exceeding eighteen feet in length had been laid down in this country, and the length of the rails for which most of the new orders were given was fifteen feet. No thirty-foot T-rails were rolled in the United States before 1855, and even at that time there was no current demand for them. The rail, like everything else connected with the railroad, grew gradually, there being distinct epochs of growth from three- or four-feet rails up to rails nine feet long, and subsequently to fifteen or eighteen feet, and even greater lengths. But in or shortly before 1850 the prevailing standard for new rails more closely approximated fifteen feet than any other standard. The weight per yard on new rails on important lines was increasing. This tendency is represented by the statement that the rails in use on the Reading railroad in 1849 were of 45, 52, 53, and 60 pounds to the yard, being 3,856 tons of 46 pounds, which had been down twelve years; 3,317 tons of 52 pounds, which had been down eight years; 777 tons of 53 pounds, which had been down seven years and 7,992 tons of 60 pounds, which had been down one to six years.

IMPROVEMENTS IN LOCOMOTIVES.

THE locomotive, like the rails and cars, and the substantiality of the permanent way, was growing during the fifth decade. Instead of weighing from four to seven tons, as at the outset, or from ten to twelve tons, as at the end of the fourth decade, it was becoming comparatively common towards the end of the fifth decade to construct new locomotives weighing a little more or less than twenty tons, and a few of the new engines weighed twenty-five tons. This increase in weight was usually accompanied with even more than a corresponding increase in effective power. Considerable advances were also made in the way of

INCREASING THE SPEED OF PASSENGER LOCOMOTIVES.

Some of the reported achievements of this class were the following:—

In 1849 Edward S. Norris, of Schenectady, built for the Utica and Schenectady Railroad a locomotive called the Lightning, with 16-inch cylinders, 22-inch stroke, and a single pair of 7-foot wheels, which ran at the rate of 60 miles an hour in 1850, but it only remained in good working condition for a short time.

Norris Brothers made seven engines for the Camden and Amboy Railroad, each with a single pair of 8-foot driving wheels, and a 6-wheeled truck. The first of these, with 13-inch cylinders and 34-inch stroke, was completed April 17th, 1849. The next of the class had 13×38-inch cylinders, and were delivered in December, 1849. In 1850 they also built two outside-cylinder engines, with 14-inch cylinders, 32-inch stroke, and coupled 7-foot driving wheels, for the New York and Erie Railroad.

In 1849 Ross Winans, of Baltimore, built a single locomotive for the Boston and Worcester Railroad. It was intended to test or render feasible the burning of anthracite coal. It was also intended for very high speed, and had one pair of 7-foot driving wheels. It had two small steam cylinders placed on the sides of the boiler over the bearings of the driving axle, by which the weight on the drivers could be raised from three to twelve tons. The speed of the engine, under favorable circumstances, was one mile in sixty seconds. It was run between Albany and Boston, drawing a train of from seven to eight cars, and ran at the rate of a mile a minute with ease.

Probably the most successful styles of the new fast engines were designed and constructed by Mr. Baldwin, of the Baldwin Locomotive Works, in response to an offer of the Vermont Central, in 1848, of $10,000 for an engine which could draw a passenger train sixty miles an hour. Three similar engines were built for the Pennsylvania Railroad Company. It is stated that these engines each weighed about 47,000 pounds. Of the locomotive delivered to the Vermont Central it is stated that "it was completed in 1849 and named after the president of the road as Governor Paine. It had one pair of driving-wheels, 6½ feet diameter, placed back of the fire-box, with another but smaller pair directly in front of the fire-box, and the front of the engine was carried by a four-wheeled truck. The cylinders were 17¼ diameter, with 20-inch stroke, placed horizontally between frames and boilers. The connecting-rods took hold of 'half-cranks' inside the driving-wheel. After several years of service it was rebuilt and made a four-coupled machine. As to its success, it has been alleged that from a state of rest it could be started and run a mile in 43 seconds, and of other similar builds for the Pennsylvania Railroad it is recorded that President Taylor was conveyed in a special train at 60 miles an hour."

INCREASE OF THE CAPACITY OF FREIGHT ENGINES.

To many American railroads it has always been more important to secure an increase in the capacity of freight engines than an increase in the speed of passenger engines, inasmuch as a very large proportion of all the railway earnings are derived from freight movements, and it was only by decreasing the cost of movement that the list and quantity of products forwarded was enlarged to the wonderful extent attained. The labors in this important field, during the fifth decade, include the following: The Baldwin Locomotive Works finished in December, 1842, one of fourteen engines ordered by the Georgia Railroad, of which J. Edgar Thomson was the chief engineer, which embraced novel features that rendered these machines popular among skillful railway managers. It is stated that these engines could draw one hundred and fifty tons up a grade of thirty-six feet to the mile; that one of them, weighing about twelve tons, on the Central Railroad of Georgia, drew nineteen 8-wheeled cars, with seven hundred and fifty bales of cotton, each bale weighing four hundred and fifty pounds, over maximum grades of thirty feet per mile; and that on the Reading railroad a similar engine of eighteen tons weight drew one hundred and fifty loaded cars (total weight of cars and loading 1,130 tons) from Schuylkill Haven to Philadelphia (favorable grade) at a speed of seven miles per hour. The regular load was one hundred loaded cars, which were hauled at a speed of from twelve to fifteen miles per hour on a level. Of the means by which these results were achieved one of the accounts of the Baldwin Locomotive Works says: "The problem of utilizing more of all the weight of the engine for adhesion remained, in Mr. Baldwin's view, yet to be solved. The plan of coupling four or six wheels had long before been adopted in England, but on the short curves prevalent on American railroads, he felt that something more was necessary. The wheels must not only be coupled, but at the same time be free to adapt themselves to a curve. These two conditions were apparently incompatible, and to reconcile these inconsistencies was the task which Mr. Baldwin set himself to accomplish. The problem was constantly before him, and at length, during a sleepless night, its solution flashed across his mind. The plan so long sought for, and which, subsequently, more than any other of his improvements or inventions, contributed to the foundation of his fortune, was his well-known six-wheels-connected locomotive, with the four front driving-wheels combined in a flexible truck. For this machine Mr. Baldwin secured a patent, August 25th, 1842."

Of subsequent movements during the fifth decade at the Baldwin Locomotive Works, in the direction indicated, it is stated that "after building, during the years 1843, 1844, and 1845, 10 4-wheels-connected engines, on the plan above described, 6 wheels in all, the leading wheels and the front driving wheels being combined into a truck by the flexible beams, Mr. Baldwin finally adopted the design of 4 driving wheels and a 4-wheeled truck. He bought the patent right for this plan of engine of Mr. H. R. Campbell, and for the equalizing beams, used between the driving wheels, of Messrs. Eastwick & Harrison, and delivered to the South Carolina Railroad Company in December, 1845, his first 8-wheeled engine, with 4 driving wheels and a 4-wheeled truck. This machine had cylinders 13¾×18 inches, and driving wheels 60 inches in diameter, with the springs between them arranged as equalizers. Its weight was 15 tons. It had the half-crank axle, the cylinders being inside, but the frame outside the smoke-box. Mr. Baldwin expressed himself more pleased with its appearance and action than any engine he had turned out, and from that time forward all of his 4-wheels-connected engines were built on this plan."

In 1846 fifteen engines were built for the Philadelphia and Reading Railroad Company by Mr. Baldwin, which were of 20 tons' weight, with cylinders 15½×20, and wheels 46 inches in diameter, and two of 25 tons' weight, with cylinders 17¼×18, and wheels 42 inches in diameter.

These 25-ton engines were probably the locomotive giants of that period.

THE LINK MOTION.

One of the important events of 1849 was the adoption of the link motion by Mr. Rogers, of the Rogers Locomotive and

Machine Company. Of this movement it is stated that other builders, including Mr. Baldwin, at first strongly resented it, but that the advantages derived from the ability it furnished of cutting off steam at any point of the stroke was admitted to be of great importance, and that "the adoption of the link motion may be regarded as the dividing line between the present and the early stage of locomotive practice."

IMPEDIMENTS TO LOCOMOTIVE IMPROVEMENTS—DIFFICULTIES INVOLVED IN THE USE OF ANTHRACITE COAL.

All the early locomotive works of this country labored under disadvantages or impediments to radical improvements, which were gradually removed, to a considerable extent, shortly after 1850, and which on some lines had been partially overcome previous to that time. They arose partly from the fact that on a very large proportion of the lines, and indeed nearly all, wood was the only fuel used. An English expert, who visited this country shortly before 1850, said that American engines labored under a manifest disadvantage because "wood being the fuel used, they are obliged to carry a high, large, top-heavy chimney, with a cumbrous spark-catcher, very different from the small, slight chimney of an English engine. It acts against the engine, not only by its size, but also by the great leverage the heaviest part, the top, has from the centre line of the whole machine."

A remarkable illustration of the tardiness with which coal-burning locomotives were adopted is furnished by a report made by George W. Whistler, jr., in April, 1849, to John Tucker, then president of the Reading railroad, in regard to the use of anthracite coal by the locomotives running on that line. As it was then the great coal railway and the great freight carrier of the country, it was particularly desirable that its engines should burn anthracite, but only a very small proportion of them were doing so at that time, and the report relates to a variety of inquiries and experiments instituted for the purpose of ascertaining and surmounting the difficulties which had prevented the general adoption of anthracite as the fuel of the locomotives used on the Reading railroad. The facts stated include the following: The very earliest of American locomotives of the type designed by Peter Cooper and Phineas Davis, used anthracite coal on the Baltimore and Ohio Railroad, without serious difficulties, but this was attributed mainly to the fact that they had vertical boilers; and when attempts were made to use anthracite on engines with horizontal boilers various obstacles arose which had only been fully surmounted on the Beaver Meadow and Hazleton roads. Success on those lines, however, was attributed to the fact that they were very short (each being only fourteen miles in length), and consequently operations upon them did not require the intense and continuous heat which was a leading obstacle to the use of anthracite on long lines, inasmuch as this heat necessitated frequent and expensive repairs. The report stated that "the principal item of excess in the cost for repairs of engines burning coal over those burning wood, is caused by the destructive effects of a coal fire upon the inside sheets of the fire-box; and when iron (the soundness of which is always uncertain from the manner in which it is at present made), has been used entirely for fire-boxes, this intense local heat has very soon blistered and burned away the sheets in the immediate vicinity of the coal fire. Another destructive effect from the use of coal is its severity on the laps or joinings of sheets in the fire place. . . . The occasional melting of grate bars, the increased liability to leakage, the wear and destruction to the ends of tubes by caulking, &c., and the accumulation and igniting of fine coal in the smoke-box, all produce their share of extra expense for repairs over wood-burning engines."

On the Baltimore and Ohio, previous to the date of this report, various experiments had been made with engines that respectively burnt wood, anthracite coal, and bituminous coal, and the conclusions based on these experiments, together with various other conclusions led Mr. Whistler to recommend that persistent efforts should be made to insure the substitution of anthracite-burning for wood-burning locomotives on the Reading railroad, remedies being suggested for the difficulties that had been developed.

It was reserved for subsequent decades to witness the general introduction of coal-burning engines, and in 1850 Ross Winans, of Baltimore, seems to have been the principal builder of such locomotives.

DEFECTIVE PERMANENT WAY.

Other obstacles to the rapid progress of early locomotive improvements arose from the relatively fragile nature of the permanent way of many American lines, and also from the lack of available ability to promptly make such repairs as might from time to time be required. But railway "SHOPS"—that word of damaging financial import in the history of many new projects—were gradually assuming larger and larger proportions. A few of them, indeed, were becoming sufficiently well equipped with skillful men and appropriate machinery to manufacture as well as repair locomotives, and important lines were strengthening their bridges, improving the methods for fastening them, and adding greatly to the solidity of their road-beds, which were no longer expected to be permanent in the sense of requiring very few repairs, but which were being made stronger and stronger to resist the heavy shocks to which they were subjected.

BRIDGES, NEW INVENTIONS, AND GAUGES.

THE READING SHOPS IN 1849.

Of the Reading shops, at Reading, in 1849, it was reported by David A. Neal that "they contain every species of machine used in the manufacture and repair of locomotives and cars, some of it very ingenious, useful, and perfect of its kind. That latterly introduced for the sawing, planing, and mortising of wood will reduce very materially the expense of making and repairing the wooden coal cars, and, with some improvements lately adopted in their construction, make them preferable hereafter, on the score of economy, to those of iron. There are now employed in these shops, in the repair of engines and cars, about 350 men and 30 boys. . . . The trip hammer shop is put to good use in converting the old materials, that are turned in at better prices than could be otherwise realized, into shafts, axles, tyres, and bar iron for the use of the road and machinery." Reference is also made to the foundry, of which the report says that it "must be considered a profitable establishment if the car wheels and other castings made here prove, as they now appear to be, good. The adoption of a new process in casting spoke wheels, by which they are made with solid hubs, will also save a large sum in fitting them."

NEW RAILWAY INVENTIONS AND APPLIANCES.

Meanwhile, from 1840 to 1850, as at all preceding and subsequent periods of railway progress, many inventors were busy in devising and patenting new machines or methods applicable to railway affairs. The list of these devices extends over a wide range, and a few of them proved useful and profitable. Favorite subjects for the exercise of inventive ingenuity included spark arresters, car springs, car wheels, bridges, methods for connecting cars, grate furnaces for locomotives, locomotive fire-boxes, the general design of locomotives or of a number of their different parts, brakes, train brakes, axles, switches, car couplings, trucks, signal lanterns, dumping cars, &c.

It is stated that shortly before 1850 the first refrigerator car was used. Some of the patents applicable to car wheels proved serviceable.

IRON BRIDGES.

In bridges a change in the direction of substituting iron for wood had been commenced, and in 1849 there were nine short iron bridges on the Reading railroad. The report of William Parker, general superintendent of the Baltimore and Ohio, for the year ending October 1st, 1850, says: "The new Savage bridge over the Little Patuxent, on the Washington branch, rendered necessary as an item of repair by the destruction of the original stone arch in the freshet of 1847, has been completed and gives much satisfaction. The superstructure of this bridge is of iron, on a comparatively novel plan, embodying valuable mechanical features, and holding out the fullest degree of encouragement as to its success and reliability. This bridge has been built at a cost of about $23,825, or $2,800 within the estimate. It is to be regretted that the late failure of an iron bridge on one of our northern railways has seemed to throw a panic over the board of directors of that line, and called forth a denunciation of 'iron bridges' from some otherwise respectable quarters."

During the fifth decade iron bridges were attracting much attention in England, and the experiments made there naturally had a tendency to stimulate corresponding movements in this country.

THE BATTLE OF THE GAUGES.

Another important feature of the railway development of the fifth decade, which left a deep impress, was the progress of construction of roads of different gauges. The general tendency was towards the adoption of a 5-feet gauge on all lines south of the Potomac and Ohio, and the adoption of a 4-feet 8½-inch gauge on lines north of these rivers, but the movement on southern roads, in favor of the 5-feet gauge, was much more uniform than the movement on northern lines, inasmuch as many of the latter adopted slight variations, such as 4 feet 9, or 4 feet 10, or 4 feet 11, and a radical departure was represented by the broad gauge adopted by the Erie and its actual and prospective connections, which was 6 feet.

The origin of two of the divergencies is reported to be as follows: When Horatio Allen devised plans for the construction of the South Carolina Railroad he concluded that mechanical requirements would be best served by a 5-feet gauge, and on account of this decision, relating to the first important southern railroad, and a desire to secure uniformity of gauge, the 5-feet gauge was almost universally adopted by southern lines.

The projectors of the Camden and Amboy favored a gauge of 4 feet 10, for reasons similar to those which led Mr. Allen to prefer a 5-feet gauge, and after it had became the established gauge for early New Jersey railroads, its extension westward to Ohio arose from the circumstance that a locomotive built by the Rogers Locomotive Works, for a New Jersey railroad, was purchased for use on one of the earliest Ohio railways, and in addition to its gauge being made to conform to the gauge of the locomotive, the sapient Ohio legislature passed an act declaring that 4 feet 10 should be the gauge of all the railways constructed in that state! Such accidental circumstances have inspired much of the legislative wisdom relating to railways, that has been displayed at state capitols.

During the fifth decade the tendency towards increasing the magnitude of the gauge divergences, as roads rapidly expanded, was scarcely less pronounced than the subsequent counteracting tendency, during the ninth decade, towards a uniform gauge standard of 4 feet 8½ inches, or its near equivalent, 4 feet 9. Various reasons for the divergences were given. Many managers thought that the standard which finally prevailed was too narrow to afford facilities for operating cars and locomotives to the best advantage, and the advocates of the broad or 6-feet gauge claimed that its adoption would render the lines to which it was applied greatly superior to the 4-feet 8½-inch roads in many respects. On the other hand, the objections made to the broad gauge, when it was proposed and adopted on some lines in England by George Stephenson, were applicable to the operations of the broad-gauge lines of this country. Smiles' life of the great railway pioneer says that "Mr. Stephenson was, from the first, opposed to the adoption of the broad gauge. He held that the gauge (4 feet 8½ inches) which had already been adopted on the northern lines was amply sufficient for the public accommodation; that it was wide enough to admit of the most effective arrangement of the machinery of the locomotive; that it was much safer to work over where the curves were at all sharp; that it was far more economical, taking into consideration the paying weight carried, in proportion to the dead weight in the shape of rolling stock; that it would cost considerably less to maintain, in consequence of the less weight to bear, and the smaller wear and tear of materials, not to mention the much smaller capital that was required to form a line upon standard gauge than upon the broad, the latter requiring more land, wider bridges and tunnels, broader embankments and viaducts, heavier rails, chairs, and sleepers, and more expensive engines and carriages. But his principal objection was that by forming the Great Western line on an exceptional gauge the proprietors of the undertaking were virtually closing it against the public traffic from other parts of the kingdom, and rendering it a mere provincial railway or by-way, instead of part of a great national system. He would not believe, with Mr. Brunel, that railways were to be confined to particular districts, but he held that, before long, they must become the universal high-roads as well as by-roads for both goods and passengers, and that any break in the continuity of the system by a difference of gauge would seriously detract from those great public advantages which their general adoption might reasonably be expected to confer." Had the force of these considerations been thoroughly realized in this country in the fifth decade a great loss of capital and much public inconvenience would have been averted.

PROGRESS OF STEAM NAVIGATION FROM 1840 TO 1860.

THE number and tonnage of steam vessels of all descriptions constructed in the United States during the fifth and sixth decades was as follows:—

	Number.	Tonnage.
From 1841 to 1850, inclusive	1,662	371,034 69
From 1851 to 1860, inclusive	2,521	730,355 33

The number and tonnage of steamers annually inspected, representing with approximate accuracy the tonnage actually employed, from 1855 to 1860, was as follows:—

Year.	Number.	Tonnage.
1855	1,073	410,013
1857	1,122	461,370
1858	1,091	415,815
1859	1,117	431,931
1860	1,208	458,857

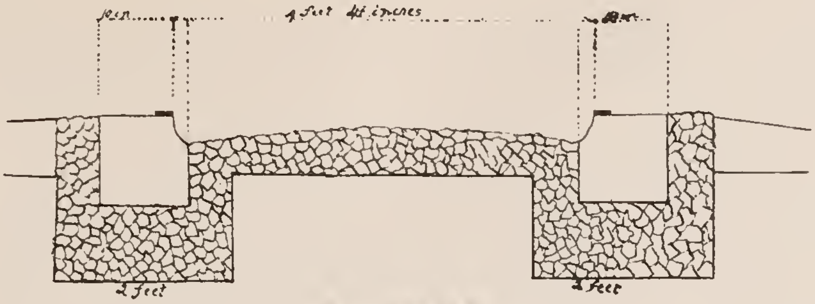
The period from 1840 to 1860 was peculiarly active and eventful in matters that had an important bearing on all classes of steam navigation interests.

ON THE NEW ENGLAND COASTS

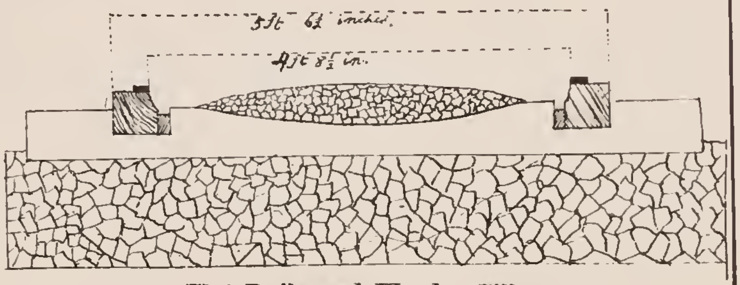
construction was much more active than at any former period, the total number of new steam vessels constructed there from 1841 to 1860, inclusive, being 179. On the middle and south Atlantic coast there was also a great increase in the number of new vessels constructed, the aggregate being 1,007.

ON THE ATLANTIC AND GULF WATERS

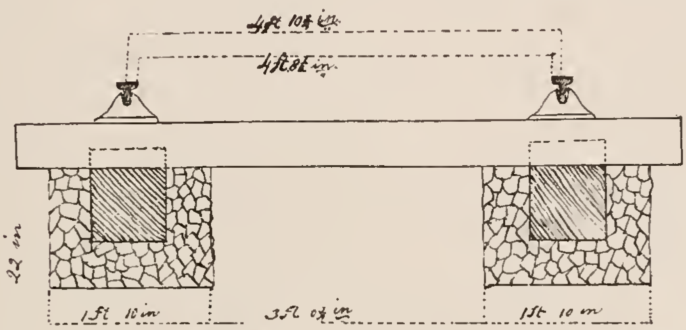
as well as the lakes important changes resulted from the introduction of the screw propeller, which commenced soon after the arrival, in 1839, from England, of an iron propeller built in accordance with plans prepared by the famous inventor John Ericsson, and ordered by Commodore Stockton. This vessel was used on the Delaware and Raritan Canal and the rivers Delaware and Schuylkill as a tug, and thus became the pioneer of a long line of propellers and tug boats, which, through improvements of the screw propeller and various



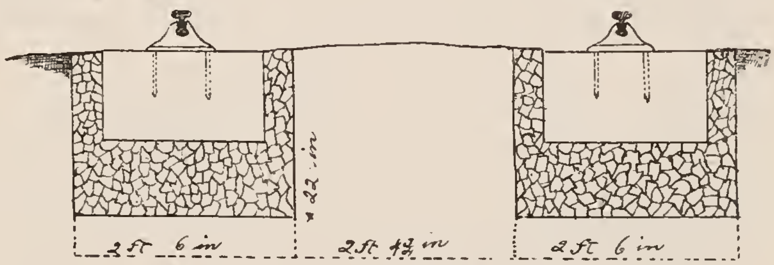
Flat Rails on Granite Sills. s.



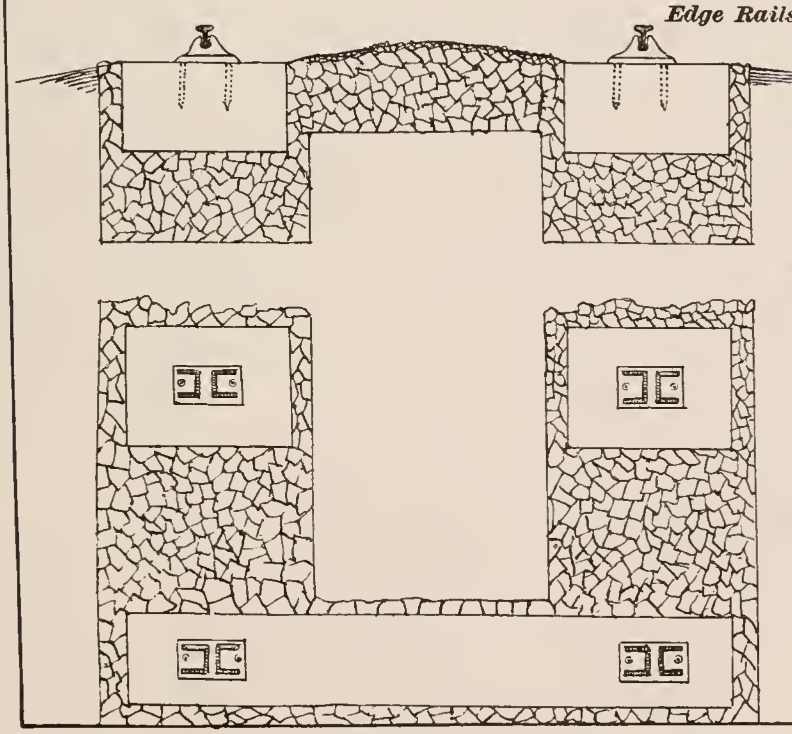
Flat Rails and Wooden Sills.



Edge Rails on Wooden Cross Sills and Bearing Timbers.



Edge Rails on Stone Blocks and Locust Sills.



Edge Rails on Stone Blocks and Stone Sills.

SYSTEMS OF CONSTRUCTION ON THE COLUMBIA AND PHILADELPHIA RAILROAD.

other devices, introduced a very important new element into a large proportion of the steam navigation of the country.

In addition to the numerous changes wrought by this invention,

TRANSATLANTIC STEAMSHIP NAVIGATION

began to assume considerable significance in 1840, when the Cunard Line was regularly established to run between Liverpool and Boston. It was soon followed by attempts to establish rival American lines, one of which, the Collins Line, achieved a great temporary success, but it was finally abandoned, partly on account of the loss of some of its vessels, but more particularly on account of the reduction and final withdrawal of subsidies of the United States government, which description of aid is of vital consequence to all American steamship lines that are compelled to run in competition with powerful steamship lines of other countries that are liberally aided by their respective governments.

The construction of ocean steamships and the establishment of foreign or American lines leading from Atlantic to European ports progressed rapidly, and it was accompanied with a number of important additions to Atlantic coast steamer lines, and a marked increase in the size and capacity of some of the steamers built in American ship-yards. The construction of iron vessels of considerable size was also commenced before the close of the sixth decade.

Various coast steamer lines were established, which sailed between New England ports, and between Boston, New York, Philadelphia, Baltimore, and other ports.

In addition to the transatlantic steamship operations, a powerful impetus was given to steam navigation by the extensive trade and immigration movements to California, which followed the discovery of profitable gold mines on the Pacific coast. The effect of all these impulses was most noticeable at New York, at which port in 1851 steamship lines were being run to foreign and domestic ports by 15 companies, which had 63 steamers, measuring 111,496 tons. The largest vessels were of 3,000 tons, which was the capacity of the four vessels of the Collins Line sailing from New York to Liverpool, and of two vessels belonging to the United States Mail Company.

THE SCREW PROPELLER.

Of the screw propeller, Hall's Census Report on the Ship-Building Industry of the United States in 1880, says: "It is not certainly known where the screw propeller was first adopted in America for tug boats, but it appears from the records that the iron tug R. B. Forbes, of Ericsson's design, was built at East Boston as early as 1845, and was supplied with twin screws, working in opposite directions. This tug was a large boat of about 300 tons burden, was especially adapted for outside work in rough water, and lived long enough to be bought by the Government during the last war. The screw was adopted for towing at Philadelphia in 1849. Some one in the city who had two towing boats of the old paddle-wheel type, saw the advantage of propeller tugs for harbor and canal use when he saw the Robert F. Stockton towing four coal barges at the rate of a mile in eleven minutes. The first propeller tug boat built on the Delaware was constructed by William Cramp, of Philadelphia, and was fitted with engines made by Jacob Neafie. She had a wooden hull 80 feet long, 17 feet broad, and 8 feet deep. This boat did excellent service on the Delaware, and her success brought a great deal of business to her enterprising builders. It was thought at first that the entire screw should be below the hull of the vessel, in order to exert its full power; but Mr. Cramp departed from that idea and fitted the Sampson with a 6-foot wheel, only half of which was below the hull, and with a 3-foot keel to protect the screw. After a number of boats had been built of that style some one wanted a light-draught tug, and the broad keel was then removed and the wheel placed entirely above the bottom of the vessel. This boat proving to be as efficient as its predecessors and much more handy, a revolution was effected in the form of tugs. The screw has now superseded the side-wheel for towing purposes, and at the present time (1882) there are more than 1,800 of these admirable boats in use in different parts of the United States, chiefly in the seacoast harbors and on the northern lakes. It is remarkable that in England paddle-wheel towing-boats have lingered in use down to the present time. The tug of our American harbors is a little propeller varying from 30 to 120 tons register. A few large size range from 130 to 170 tons register, but the average tug is of about 80 tons, and is about 90 feet long, 18 feet wide on the beam, and 9½ feet deep in the hold."

INCREASE OF SIZE AND SPLENDOR OF EASTERN RIVER STEAMBOATS.

Another noticeable development was the increase of the size of steam vessels of all descriptions, and especially of the eastern river steamboats. In discussing this subject Hall's report on ship building says:—

"While England was pushing out to all parts of the world, America was developing her river and lake boats. After the opening of the Erie Canal the Hudson became the scene of the busiest internal traffic then ever seen. The west, which at the beginning of the century had been a trackless wilderness, was filling up with people. Trade was springing up rapidly on the lakes and western rivers, and a general increase in the size and the number of steamboats and lake propellers took place. On the lakes, where there was depth of water, the boats increased in all their dimensions, but on the rivers, where they could not venture on more than six to eight feet draught, they were limited to extending the length and breadth. It is hardly necessary to follow the successive steps by which the river steamers attained the extraordinary dimensions which have been given them in the last twenty years. Suffice it to say that the spirit of rivalry led to the construction of vessel after vessel constructed to surpass everything which had preceded it in the power of its engines, the fastness of its trips, the size and magnificence of the palace built upon its decks for the accommodation of passengers, and in its capacity for carrying deck-loads of freight. When the New World was finished for the Hudson river it was the longest and fastest vessel in the world, being 380 feet from stem to stern. The hull was 50 feet wide; the entire width over the wheels was 85 feet, and the wheel was 45 feet in diameter. The hog-frame of this boat rose 25 feet above the deck, and a row of masts from 40 to 50 feet in length, heeling on the keelson, capped with iron, and rigged with iron rods or shrouds, extending to the sides and ends of the boat, aided to impart rigidity to the light and shallow hull. Several strong longitudinal keelsons were put in to add to her strength, and keep her broad, flat floor in shape. Her cabins were of immense size, and few hotels at that day could accommodate so many travelers. There were 347 state rooms and 600 berths. The cabins contained elegant parlors, sumptuously decorated with carved work and gilding, rich carpets, and costly furniture. There was also a large dining room for the entertainment of guests. Her speed was 20 miles an hour. Large as was this remarkable vessel, her length has since been eclipsed by the St. John, built for the same river in 1864, which was 407 feet from stem to stern. Her register dimensions were: Length, 393 feet; beam, 51 feet; depth of hold, $10\frac{8}{12}$ feet; gross tonnage, 2,645. She was built at Greenpoint. Nothing had been built since the historic galley of Ptolemy Philopater that approached her, that boat having been her superior in length by 13 feet, and the expensive steamers of the transoceanic service only now exceed her length. In speed these Hudson river boats have never been beaten. The Daniel Drew, the Mary Powell, and others have made from 25 to 28 miles an hour, and sustained that speed over long stretches of that river. The steamboats of New York city have been admired by the builders of the whole world for the excellence of their construction. The cabins have been the most costly part of these vessels, owing to their size and the luxury of their joiner work, the carving, gilding, decorating, and furnishing. Nevertheless, the hulls have displayed the greatest ingenuity. Light, strong, and durable, they have never been excelled in the qualities that make them remarkable. They are modeled flat on the floor amidships to secure small draught, and are given long, sharp bows and long, narrow runs to secure speed. The form of the model entails weakness, but builders have found a way to give the boats the slender scantling that preserves their light draught, and yet to make them strong enough to withstand the action of powerful marine engines. Excellence of framing, toughness of fastening, and the use of none but the very best materials secure this result."

BUILDING ON THE NORTHERN LAKES.

The number of steam vessels built on the northern lakes from 1841 to 1860, inclusive, was 345, a considerable number of which were of larger size than those previously constructed. The relative number of propellers increased rapidly. In 1855 the steam inspection service reported the number of steamers on the northern lakes as follows: Licensed steamers 128, measuring 68,089 tons, and unlicesened steamers 115, measuring 21,252 tons. Up to 1850 there had been built on the lakes 50 propellers, measuring 16,427 tons.

STEAMBOATS ON THE WESTERN RIVERS.

The reported number of steamboats constructed on western rivers (exclusive of the Pacific coast), from 1841 to 1860, was 2,489. The size and speed of some of the steamboats was considerably increased, and on the other hand, additional skill was developed in the construction of boats of light draft intended to navigate the shallow tributaries of the Mississippi. Before 1840 the popular size of western boats was from 100 to 300 tons register, but a few larger ones of from 400 to 600 tons were engaged on the long routes.

In 1852 the average size of steamboats then running on the lakes was 437 tons; of steamboats on the Ohio basin $306\frac{23}{95}$ tons; and of steamboats on the Lower and Upper Mississippi, the Arkansas, Missouri, and the Illinois rivers $273\frac{74}{95}$. There were then on the Mississippi and Ohio many steamers of from 300 to 500 tons each, and a number of from 600 to 800 each. Several of the passenger steamers of the lakes were of 1,100 tons and upwards each.

After 1840 larger and swifter boats were constructed for passenger service below Cincinnati, and on the Mississippi, from St. Louis to New Orleans. One of the most celebrated of these boats, the Eclipse, attained a speed of 16 miles an hour, in sailing up stream, and frequently made 25 miles an hour in sailing down stream.

WESTERN RIVER AND STERN-WHEEL STEAMBOATS.

A very important class of western river boats, however, were of comparatively small tonnage, as they were intended to be operated on tributary rivers.

Of a boat, used on the waters of the Cumberland about 1856, Frederick Law Olmstead, in his journey through Texas, gave the following description:—

"The boat was a good specimen of a very numerous class on western and southern rivers. They are but scows in build, perfectly flat, with a pointed stem and a square stern. Behind is the one wheel, moved by two small engines of the simplest and cheapest construction. Drawing but a foot, more or less, of water, they keep afloat in the lowest stages of the rivers. Their freight, wood, machinery, boilers, hands, and steerage passengers are all on the flat deck just above the surface of the water. Eight or ten feet above, supported by light stanchions, is laid the floor used by the passengers. The engines being horizontal, this floor is laid out in one long saloon eight or ten feet wide from the smoke-pipes, far forward, which stretches to the stern. It is lined upon each side with state-rooms, which open also out upon a narrow upper guard or gallery. Perched above all this is the pilot house, and a range of state-rooms for the pilots and officers, popularly known as 'Texas.' To this Texas inveterate card players retire on Sundays, when custom forbids cards in the saloon. A few feet of the saloon are cut off by folding doors for a ladies' cabin. Forward of the saloon the upper deck extends around the smoke-pipes, forming an open space, sheltered by the pilot deck, and used for baggage and open-air seats. Such is the contrivance for making use of these nautical highways. And really admirable it is, spite of drawbacks, for its purpose. Without it the west would have found it impossible to be The West. Roads, in countries so sparsely settled, are impracticable. These craft paddle about, at some stages of water, to almost every man's door, bringing him foreign luxuries, and taking away his own productions, running at high water in every little creek, and at low water, taking, with great profit, the place of the useless steamers on the main streams."

Some of the perils and annoyances connected with this mode ot locomotion soon became apparent, however. The steamboat struck a snag, and broke several buckets of its wheel. After being partially repaired it frequently grounded, and, although it was always released after more or less delay, it was at last "driven hard and fast by rapids upon a heap of rocks barely covered with water."

The writer proceeds to explain how they were released from this dilemma: "Then it was we learned the use of those singular spurs which may always be seen standing on end against the forward deck in any picture of a western boat. They are, in fact, steamboat crutches. One of these, or the pair if occasion require, is set upon the river bottom, close to the boat's head, and a tackle led from its top to a ring in the deck. Then, by heaving on the windlass, the boat is lifted bodily off the ground. As soon as she swings free of bottom steam is applied with fury, and forward she goes until the spur slips from its place, and lets her fall. . . . We were amused to notice of how little account the boat was considered, in comparison with the value of time. Whenever any part of the hull was in the way of these spurs, axes were applied without a thought, other than that of leaving hull enough to keep afloat. In fact, costing little, these steamers are used with a perfect recklessness. If wrecked, why, they have long ago paid for themselves, and the machinery and furniture can always be saved. This apparatus of stilts is used upon the longest boats, and good stories are told of their persistence in lifting themselves about, and forcing a passage over gravel banks whenever freights are higher than steamboats. The 'first boat over' sometimes wins extravagant rewards. When sugar, for instance, goes up to one dollar per pound in up-river towns, after a dry season, a few hogsheads will almost pay for a cheap steamboat."

PERILS OF STEAMBOAT NAVIGATION—IMPROVED SYSTEM OF INSPECTION.

An important change in the system of inspecting steamboats was adopted about 1852, which, in connection with the removal of snags and conservative regulations, did much to diminish the danger of steamboating on the western rivers, and also to improve the safeguards of the steam navigation of all other sections. The magnitude of the perils that attended early western steamboat operations is indicated by the fact that a list containing the names of 618 steamboats, lost on the rivers of the Ohio basin and the Mississippi valley, from the period of the first introduction of steam navigation thereon to the close of the year 1848, was prepared by Captain Davis Embree, one of the oldest steamboat masters engaged upon the western waters. The list shows the place where and the time when each of the boats so lost was built; the amount of its tonnage; the date of its loss; the length of time it had been running when lost; its original cost; the depreciation of its value by use, and the sum finally lost by its destruction. Of the 618 boats it embraces, 45 were lost by collisions, 104 by fires, and 469 by snags and other obstructions to navigation.

The following statement shows aggregate results:—

Causes.	No of boats.	Tonnage.	Original cost.	Depreciation of value.	Local lines.
Lost by collisions.....	45	7,769	$730,286	$346,762	$383,524
Lost by fires...... ...	104	22,058	2,064,512	1,096,143	......
Lost by snags.........	469	79,261	7,104,950	3,733,852	3,368,438
	618	109,088	$9,899,748	$5,176,757	$4,719,991

The losses sustained through explosions, collapsing of flues, and bursting of steam pipes, are not included in this statement.

During 1851 the number of enrolled steam and sail vessels lost on the lakes was 42, and on the rivers 33, involving a loss of life on the lakes of 67 persons, and on rivers of 728 persons.

STEAMERS ON THE PACIFIC COAST.

In accordance with the American custom of having the steamboat either precede or immediately follow the march of civilization, steamboats were promptly introduced into California after the discoveries of gold had attracted population to that state, and a few steamboats were also built and operated in Oregon at a comparatively early period.

In 1850 there were sixteen steamers with a tonnage of 2,277.25 running on the Sacramento river. One of them, the Senator, of 755 tons, has the reputation of having made more money than any boat ever built in the United States. Its extraordinary success was due to its ability to command for a time fares of $25 from San Francisco to Sacramento, and $30 from Sacramento to San Francisco. The charges for this service were soon reduced by rivalry to $1. The increase of the number of steamers and damaging competition were followed by the usual process of a consolidation of the interests of competing companies,—an expedient which the steamboat owners of various districts have been quite as ready to adopt as railway lines. In 1853 there were 25 steamers with a tonnage of 5,099.50 running to and from Sacramento; and in 1854 it was reported that all the steamships plying on the Sacramento, San Joaquin, American, Feather, and Yuba rivers, had joined fortunes, with a capital of $2,000,000. The number of steam vessels inspected at San Francisco, in 1860, was 43, and their tonnage 23,493.

Of the oceanic steamship service of California it is stated that the Pacific Mail steamer California, which left New York on the 6th of October, 1848, was the first steamer to enter on the Pacific coast trade. As the gold fever developed the California was followed by others in quick succession. The Pacific Mail Company gained a strong footing, though the maintenance of the line so far from the base of supplies was a difficult and expensive undertaking. Coal, whether from England or from the United States, was sent around Cape Horn, and cost not less than $20 per ton, and for a large part of the time the Pacific Mail Company had to pay $30 per ton, and in one instance $50 per ton was paid.

ATLANTIC COAST IMPROVEMENTS OF WATER CRAFT.

At all stages of the development of transportation systems in the United States the characteristics and amount of water craft used have possessed great intrinsic significance and borne an important relation to contemporaneous land movements. During early periods it was impossible to move bulky articles over long distances on land at a cost which would not exceed their value at the point of export or consumption, and, therefore, all lengthy movements of cheap and bulky dead freight were necessarily made by water. As there were many localities too remote from natural or artificial channels to utilize their benefits, the available area of production for a considerable number of cheap staples was comparatively limited.

Railway development has since attained such immense magnitude, and extended to so many sections, that there are few districts or products which cannot now secure access to desirable markets, either by all-rail or combined rail-and-water movements. In the progress of these changes there has been a strong general tendency towards an increase of the relative length of the rail movements when combinations with water movements were necessary, and towards the complete substitution of rail transportation for water and combined rail-and-water transportation.

Efforts of inventive genius, and especially the application of steam power to navigation, have borne a very important relation to the internal, coastwise, and foreign commercial movements of the country.

Out of the rivalries between a number of land and water routes, intermingled with the necessity of operating many railways in antagonism to various water carriers, and in harmony or cordial co-operation with others, sundry popular or political controversies have grown, and speeches in favor of river and harbor bills are sometimes freely interlarded with declarations that many of the works for which appropriations are made are either necessary or very useful for the protection of the people from exorbitant railway charges. The importance of such theories is often exaggerated, but it is nevertheless true that some of the light-house, coast survey, and river and harbor appropriations have had an important influence in increasing the efficiency of water craft, and in rendering possible the substitution of large for relatively small vessels, steamboats, steamers, and steamships, thereby cheapening the cost of water transportation, and increasing the difficulty of successful rail competition between some points for sundry classes of traffic.

Water routes have always formed an important element, however much their relative rank in some localities and for some purposes has been lowered. In all external trade, or foreign commerce, with any other countries than the New Dominion or Mexico, water routes are indispensable; and for a number of classes of internal and coastwise trade they continue to afford the cheapest and most convenient channels.

THE ATLANTIC OCEAN AND ITS TIDAL APPROACHES

have always formed much the most important of the American water-courses for many domestic purposes, as well as for the bulk of all foreign commercial movements. Generally speaking, and making due allowance for extensive developments elsewhere, the Atlantic and gulf of Mexico may be said to form the principal base of the transportation system of the United States. Nearly all roads and all lines start from, lead to, or connect with some one or more of the Atlantic or gulf ports, and on the Atlantic and gulf waters a large proportion of the commercial movements between various states and sections have always been made.

In the construction of vessels adapted to such service, and in changing their structure with new requirements, much ingenuity has been displayed, not only since steam vessels have been extensively used, but at all stages of the numerous vicissitudes that have attended the operations of sailing vessels. In wooden ship building this country gained a front rank, and steadily maintained it during a protracted period. American genius in constructing oceanic steam vessels, intended for competitive foreign trade, has not been fully developed, on account of the payment of large subsidies by other nations and a neglect or refusal to make such payments by the United States government; and adverse circumstances have at various periods driven American sailing vessels from lucrative branches of foreign trade. The principal resource in all such emergencies has been in domestic commerce along the Atlantic coast. This great field for the employment of American shipping has always been monopolized by national vessels, and the actual amount of commercial water domestic transportation on the Atlantic and gulf waters has at all times been very much greater than on any other American routes. While American tonnage was being increased from 1,368,127.78 in 1815 to 5,049,808.35 in 1858 the proportion employed in the coasting trade fluctuated materially, but it was always large, and during comparatively recent periods it increased rapidly. Of the tonnage ordinarily built one-half and frequently from two-thirds to three-fourths is built and used on the seaboard. There have been a few years, however, in which the tonnage built on the great lakes and the Mississippi river and its tributaries, combined, was greater than that constructed on the Atlantic.

Greatly as the shipping interests identified with foreign trade have declined in relative rank, and partly, perhaps, on account of this decline, the number and variety of vessels engaged in domestic commerce has expanded to a very remarkable extent. In the aggregate they form much the most extensive, efficient, and diversified coasting fleet in the world. The number of vessels is reckoned by tens of thousands; their tonnage ranges through all desirable grades from the lowest to the highest, and important advances in all descriptions of marine architecture, including steamers and sailing vessels of many sizes, are constantly being made.

The Atlantic craft of all kinds may be divided into three general classes, one of which is devoted to coasting trade exclusively, and, therefore, at all times an adjunct of local or interstate commerce; another is devoted exclusively to trading operations between American and foreign ports; and another is registered and fully qualified in all respects to engage in foreign commerce, which furnishes employment whenever it is deemed the most desirable or lucrative, but this class frequently engages also in coastwise or domestic commerce. Indeed, all American vessels engaged in foreign commerce have the privilege, whenever they choose to exercise it, of engaging in any branch of domestic or coastwise traffic, and this right has been very frequently exercised, while additional custom-house formalities are necessary to enable a vessel that is only licensed or enrolled to engage in foreign commerce. There have been periods when it was common for some classes of vessels to engage in foreign trade during certain portions of each year and coasting trade in other portions of the same year.

INCREASE IN SIZE OF VESSELS.

Of an American merchantman built in 1841, of 1,133 tons, it was said that she was then the largest in the world. A few previous attempts to find remunerative traffic for vessels of about 1,000 tons had generally proved unsuccessful, and comparatively few merchant vessels of more than 500 tons were built, but after 1850 large merchant vessels were frequently constructed, a tonnage exceeding 2,000 being not uncommon, and one of the vessels of 1853, the Great Republic, having a tonnage of 4,555. This increase of the size of merchant vessels, increase of the number of vessels of all sizes applicable to coasting trade, and extensive application of steam to vessels engaged in plying between Atlantic ports, have had the effect of making the Atlantic and its tributary waters a much more important channel than any other of transportation movements that compete with one class or another of railway operations, and at the same time constitute aids of incalculable significance to many descriptions of industrial labors and commercial exchanges.

There is scarcely any sort of freight traffic originating at or destined for points near the Atlantic coast, that cannot be or is not alternately moved by rail and vessel, and railway interests are so complex and antagonistic that there is scarcely any important line which is not constantly throwing the full weight of its influence for some of the Atlantic water routes against others. The wonderful reductions in the cost of water movements arising from an increase in the size of vessels, improvements of rivers and harbors, and use of steam, have exerted a powerful influence in stimulating railways to reduce the cost and charges of their competitive movements, and in this strife between land and water systems the Atlantic has been one of the most important factors. It is the one great channel which never freezes, never suffers from low water, and which can be traversed with equal facility in all directions.

RAILWAY CONSTRUCTION IN THE SIXTH DECADE.

MAGNITUDE OF THE EXTENSIONS.

DURING the sixth decade of the nineteenth century, from 1850 to 1859, inclusive, railway construction progressed with marvelous rapidity. The events of that epoch have left an indelible impress upon the transportation systems of the country, on account of the extraordinary magnitude of the additions made to mileage, the peculiarly advantageous location of many of the lines and extensions, and the gigantic strides towards an advancement of railways as leading agencies for all descriptions of freight and passenger movements.

Daniel Webster said, about 1820, that the improvement in American facilities for transportation during the preceding score of years, or the first two decades of the nineteenth century, in the way of constructing turnpikes, bridges, canals, and improving roads, exceeded in importance all the advances made from the time of the first colonial settlements up to the close of the eighteenth century. It is scarcely an exaggeration to say that the railway construction of the sixth decade approximately equaled, if it did not exceed, in actual expenditure and amount of labor performed, all that had previously been done in this country in creating useful internal improvements.

It is impossible to convey an adequate idea of the importance of the work accomplished without descanting at length upon the particulars which are appended, but the magnitude of the tasks achieved may be inferred from the statement of the preliminary report on the census of 1860, that the railway mileage was increased from 8,589.79 miles in 1850 to 30,793.67 miles in 1860, and that the cost of construction was swelled from $296,660,148 in 1850 to $1,151,560,829 in 1860. Here was an absorption of $851,900,681 by a single interest in less than ten years, and that was a great deal of money "before the war."

The states in each of which more than one hundred millions of dollars was expended for new lines included Pennsylvania, Ohio, and Illinois, and in proportion to resources and ability to supply traffic Virginia, Alabama, Mississippi, Louisiana, Tennessee, Indiana, Michigan, Wisconsin and Missouri were quite as progressive as the three states first named.

It is difficult to account for the immense forward strides made during the decade on any other theory than that a large portion of the country, and foreign capitalists, were dazzled by the tremendous display of wealth apparently resulting from the discovery and successful operation of the California and other American gold and silver mines, and the passage of the Kansas and Nebraska act of 1854, which first opened for settlement the entire region west of the Missouri, and thus nearly doubled the available area of the Republic.

RAIL CARRIERS TAKE THE LEAD OF WATER CARRIERS.

Before 1850 the aggregate amount of domestic traffic transported on the lakes, the gulf, the rivers and canals, and coastwise on the Atlantic, greatly exceeded the contemporaneous movement on American railways. After 1860 the relative importance of land and water carriers was radically changed, and ever since that period cars have continued, in a steadily increasing degree, to exceed boats, vessels, and all descriptions of water craft combined, in the amount of freight and number of passengers conveyed between different points in the United States.

The extent of this transition is partially indicated by the fact that the number of persons returned as railroad men in the list of occupations in the United States, as furnished by the census returns of 1860, had increased from 4,831 reported in 1850 to 35,567, and these figures fell far below current estimates. The number reported in each state and territory in 1860 was as follows: Alabama, 626; Arkansas, 133; California, 65; Connecticut, 655; Delaware, 84; Florida, 110; Georgia, 948; Illinois, 2,514; Indiana, 1,806; Iowa, 738; Kansas, 2; Kentucky, 904; Louisiana, 147; Maine, 502; Maryland, 745; Massachusetts, 2,075; Michigan, 791; Minnesota, 11; Mississippi, 466; Missouri, 1,560; New Hampshire, 853; New Jersey, 1,153; New York, 6,272; North Carolina, 366; Ohio, 3,041; Pennsylvania, 3,729; Rhode Island, 162; South Carolina, 364; Tennessee, 2,194; Texas, 44; Vermont, 881; Virginia, 1,583; Wisconsin, 1,024; Nebraska, 6; District of Columbia, 13. The number of steamboat men reported in 1860 was 7,553, and the number of canal men 2,699.

Aside from temporary interruptions, or the pressure of peculiarly adverse influences, the four great water systems by which the older portions of the country are environed, viz., the Atlantic, the gulf, the Mississippi, the lakes and their eastern outlets, have steadily continued to furnish channels for extensive movements, and they probably always will. But in the early days of development they supplied the only channels for lengthy movements of bulky articles; up to the end of the fifth decade their supremacy was scarcely affected in a serious degree; after 1860 they assumed a subordinate position, although it was still a very important one.

NEW ROADS EAST OF THE ALLEGHENIES.

The list of railways constructed east of the Alleghenies included a number of important local lines; roads connecting some of the New England states, which rounded off the system of that section; important north and south lines in several of the Southern Atlantic states; useful bituminous coal roads, and material additions to the list of anthracite railways, which included not only considerable extensions of the old coal roads, but the construction of the Lehigh Valley and the Delaware, Lackawanna and Western. The New England construction exceeding one hundred miles in length included 114.58 miles by the Atlantic and St. Lawrence, 122.20 miles by the New York and New England, and 173.40 miles by the Maine Central. In New York, in addition to the marked advance of her trunk lines, 171.86 miles were built by the Rome, Watertown and Ogdensburg. In Pennsylvania, the Philadelphia and Erie constructed 146 miles, and the Philadelphia and Reading 107.10, aside from the active efforts of the Pennsylvania to complete its main line. The additions to mileage in the Southern Atlantic states include 146 miles by the Atlantic, Gulf and West Indian Railroad and Transit Company; 428.36 by the Atlantic, Mississippi and Ohio (now the Norfolk and Western); 188 by the Carolina Central; 106.40 by the Charlotte, Columbia and Augusta; 146.80 by the Chesapeake and Ohio; 144.65 by the Richmond and Danville; 109 by the Selma, Rome and Dalton; 163.50 by the South-western Railroad, of Georgia; 221.20 by the Washington City, Virginia Midland and Great Southern; 138 by the Western and Atlantic, and 149 by the Washington and Ohio.

THE EAST AND WEST TRUNK LINES.

As the vicinity of the interior water channels of the Mississippi and its tributaries, and the lakes and their connections, furnished the locations of the homes of a very large proportion of all the pioneers who had emigrated west of the Alleghenies, and their descendants, various places on the water courses formed the principal objective points of much of the construction perfected during the sixth decade.

The era was peculiarly prolific in completing the links of connection between all the important Atlantic seaboard cities and the great west. What New York had accomplished in 1825 by her Erie Canal, and Pennsylvania a few years later by her main line, in the way of furnishing artificial avenues across the mountains, was much more thoroughly accomplished through rail connections, by every ambitious seaboard state; and with the completion of these competing lines, which each aimed to secure a share of the traffic of the Mississippi valley, and which were each then considered possible carriers of much of the through business secured by either contestant, began an unparalleled strife for the privilege or opportunity of moving persons and property.

The list of this class of roads, commonly known as the trunk lines, and their southern competitors, which were only fairly brought into action during the sixth decade, includes the New York Central (for although its different links had been previously constructed, they were consolidated, and thus rendered effective as through freight carriers, in or about 1854); north-eastern connections of the Grand Trunk, of Canada, by which Portland and Boston gained access to the west, some of which were completed in 1850, and others opened in 1853; the New York and Erie, opened on the 22d of April, 1851; the Pennsylvania, opened in 1852, but then laboring under disadvantages, which were subsequently removed during the decade, first by opening its mountain division, and at a later date by purchasing the main line of the state works; the Baltimore and Ohio, opened in 1853; the extension westward in 1858 of the Virginia system of railroads, by which a connection was secured with the Memphis and Charleston, and Nashville and Chattanooga railroads; and the opening of the Western and Atlantic, leading from Atlanta to Chattanooga, in 1850, which furnished to Georgia and her seaboard cities a connection with the Tennessee river, analogous in significance, in that latitude, to the extensions of the northern trunk lines to their respective termini at Buffalo, Dunkirk, Pittsburgh, and Parkersburg. Here were seven distinct railway routes, which each furnished an avenue open all the year round, leading, with comparatively few deflections, from a direct route between Atlantic seaports and lines connecting with points contiguous to the heart of the Mississippi valley, which either crossed or flanked the great natural barrier between the interior and the Atlantic ocean, and which, while they each promoted local ends of great importance, aimed, with more or less force and determination, to secure a large share of through traffic. Most of them stimulated the erection along their lines of a greater array of productive industries than had ever previously been concentrated in the vicinity of any interior river or other water-course, and prospered or failed in proportion to the magnitude of this local development.

FOUNDATION OF GREAT WESTERN SYSTEMS.

Before most of the trunk lines had reached their western termini, as originally projected, much had been done to construct connecting lines which would extend from those terminal points to leading western cities. During the sixth decade a number of important roads of this class were completed. The Pennsylvania had been particularly active in assisting the construction of lines extending westward or northward from Pittsburgh, and some of the fruits of this activity and of the independent exertions of various companies or organizations are to be seen in the completion of 124.42 miles by the Pittsburgh, Cincinnati and St. Louis; 468.32 miles by the Pittsburgh, Fort Wayne and Chicago; 197.66 miles by the Cleveland and Pittsburgh; and 400.30 miles by the Columbus, Chicago and Indiana Central. To what subsequently became the Vanderbilt system, a number of corresponding additions were made, including 390.95 miles constructed by the Cleveland, Columbus, Cincinnati and Indianapolis; and 720.35 miles by the Lake Shore and Michigan Southern. The Baltimore and Ohio gained important allies leading to Cincinnati and St. Louis by the construction of 258.40 miles by the Marietta and Cincinnati; and 338.05 miles by the Ohio and Mississippi. To provide connections between leading points on the Ohio and the Mississippi, and the southern trunk lines extending across the Alleghenies, 270 miles were constructed by the East Tennessee, Virginia and Georgia, 290 miles by the Nashville, Chattanooga and St. Louis, and 290 miles by the Memphis and Charleston. A number of other roads designed to serve analogous purposes were constructed, which might be classified under the general head of western connections of the trunk lines.

Another important class of roads which sprung into existence aimed at providing connections between the Ohio and Mississippi rivers and lake Erie or lake Michigan. By such lines the Mississippi was reached at ten points, and the Ohio at eight different points. To a certain extent nearly all these lines were built either in the interest of their terminal points, or with the expectation of attracting traffic to them, one set being intended to promote the prosperity of Cleveland, and others, respectively, of Toledo, Cincinnati, Chicago, Louisville, St. Louis, Columbus, Indianapolis, or less prominent cities. Chicago was particularly fortunate in strengthening her railway connections, and broad foundations were laid for the expansions which have since made her one of the greatest railway centres of the world. Louisville not only aimed at securing northern outlets to the lakes, but 222.53 miles of the Louisville and Nashville were constructed, by which important connections with interior Kentucky and Tennessee, and subsequently other states, were secured. St. Louis adopted a similar policy by securing connections in Missouri, extending westward, as well as eastern outlets; and Milwaukee began to gain prominence as a railway centre as well as a lake port.

The amount of construction completed by some of the great western lines not heretofore specially referred to includes 220.10 miles by the Chicago and Alton; 405.82 by the Chicago, Burlington and Quincy; 665.77 by the Chicago, Milwaukee and St. Paul; 428.90 by the Chicago and North-western; 286.25 by the Chicago, Rock Island and Pacific; 705.50 by the Illinois Central, and 531 by lines subsequently combined with the Wabash, St. Louis and Pacific.

TRANS-MISSISSIPPI, GULF STATE, AND PACIFIC RAILROADS.

Extensive preparations were made to extend railways west of the Mississippi, and a considerable amount of work was done on lines west of that river. The first of some of these efforts in Missouri include the construction of 206.41 miles by the Hannibal and St. Joseph; 171.25 by the Missouri Pacific; 89.69 by the St. Louis, Iron Mountain and Southern.

Still another class of railways which attracted much attention were lines built to connect gulf cities with the Ohio or Upper Mississippi, thus partially paralleling the Father of

Waters, and aiming at attracting the traffic of central portions of the Mississippi valley southward instead of permitting it to go either northward to the lakes or directly eastward. Construction of this class included the completion of 347.50 miles by the Mobile and Ohio, and 442 by the Chicago, St. Louis and New Orleans, now the southern extension of the Illinois Central.

A small amount of mileage was also completed in Texas and California, and a series of elaborate surveys of rail routes between the Mississippi valley and the Pacific coast established a broad basis for the subsequent efforts to construct transcontinental roads.

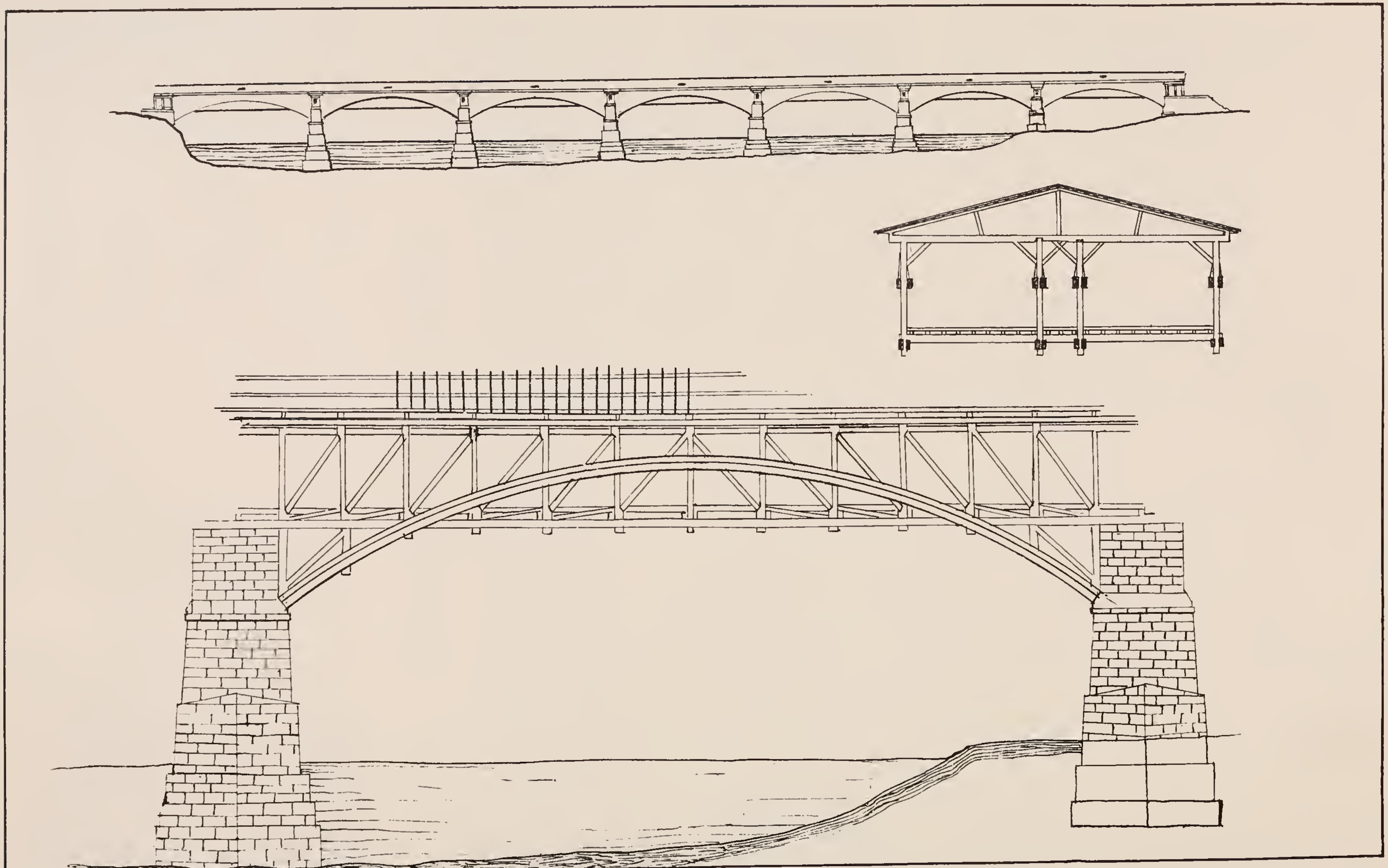
ADDITIONS TO RAILWAY MILEAGE FROM 1850 TO 1859.

The number of miles completed at the end of each year of the sixth decade was as follows: 1850, 8,571.48; 1851, 9,845.94; 1852, 12,134.38; 1853, 14,304.00; 1854, 17,746.16; 1855, 20,198.99; 1856, 21,669.86; 1857, 23,746.90; 1858, 25,712.95; 1859, 27,420.07. The number of miles constructed in each geographical group, during the sixth decade, was as follows: Group I. The New England states, 1,382.67; Group II. New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, District of Columbia, 8,479.57; Group III. Virginia, West Virginia, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, South Carolina, 5,424.26; Group IV. Illinois, Iowa, Wisconsin, Missouri, Minnesota, 4,607.70; Group V. Louisiana, Arkansas, Indian Territory, 100.75; Group VI. Dakota, Texas, California, &c., 114.68. The following table shows the number of miles constructed in each year, by each company, as reported by the operating companies to the census bureau in 1880:—

Corporation.	Miles of railroad built, 1850–59.										
	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	Decade.
GROUP I. MAINE, NEW HAMPSHIRE, VERMONT, MASSACHUSETTS, RHODE ISLAND, CONNECTICUT.											
Ashuelot	23.73	....	....	....	....	....	....	....	....	....	23.73
Atlantic and St. Lawrence	11.00	....	44.25	58.08	1.25	....	....	....	....	....	114.58
Bennington and Rutland	....	....	58.90	....	....	....	....	....	....	....	58.90
Boston and Albany	....	....	....	9.30	....	....	....	....	....	....	9.30
Boston, Clinton, Fitchburg and New Bedford	13 90	....	....	....	....	16.47	....	....	....	....	30.37
Boston, Concord and Montreal	13.62	19.38	....	43.43	....	....	....	....	....	....	76.43
Boston and Lowell	16.80	....	....	....	....	....	....	....	....	....	16.80
Central Vermont	....	22.60	....	....	....	....	....	....	....	....	22.60
Concord	....	....	5.00	....	....	....	....	....	....	....	5.00
Concord and Claremont	8.52	....	....	....	....	....	....	....	....	....	8.52
Concord and Portsmouth	....	....	29.02	....	....	....	....	....	....	....	29.02
Connecticut and Passumpsic Rivers	40.00	....	21.00	...	....	....	....	29.00	....	....	90.00
Danbury and Norwalk	....	23.80	....	....	....	....	....	....	....	....	23.80
Danvers	....	....	....	9.26	....	....	....	....	....	....	9.26
Dover and Winnipiseogee	....	10.25	....	....	....	....	....	....	....	....	10.25
Eastern (of Massachusetts)	28.02	....	....	15 85	....	....	....	....	....	....	43.87
Fitchburg	20.84	....	3.17	....	....	3.54	....	....	....	....	27.55
Grand Trunk (of Canada), section of in United States	....	....	....	16.00	....	....	....	....	....	....	16.00
Horn Pond Branch	....	....	...	....	0.66	....	....	....	....	....	0 66
Maine Central	....	12.00	53.10	....	....	76.60	5.90	21.60	....	4.20	173.40
Manchester and North Weare	19.50	....	....	....	....	....	....	....	...	....	19.50
Newburyport	....	14.98	....	....	12.00	....	....	....	....	....	26.98
New Haven and Northampton	28.17	....	....	....	....	....	....	29 80	....	....	57.97
New London and Northern	64.88	....	....	20.00	....	....	....	....	....	....	84.88
New York and New England	17 90	....	6.20	2.30	81.10	14.70	....	....	....	....	122.20
New York, New Haven and Hartford	9.84	....	....	....	....	....	....	....	....	....	9.84
New York, Providence and Boston	....	....	....	....	....	....	....	12.40	....	....	12.40
Norwich and Worcester	....	....	....	....	6.73	....	....	....	....	....	6.73
Old Colony	....	....	....	1.65	18.34	....	8 04	....	....	....	28.03
Portland and Rochester	....	....	....	18.00	....	....	....	....	....	....	18.00
Portsmouth, Great Falls and Conway	....	....	2.00	....	....	4.00	....	....	....	....	6.00
Providence, Warren and Bristol	....	....	....	....	....	13.60	....	....	....	....	13.60
Rutland and Whitehall	6.83	....	....	....	....	....	....	....	....	....	6 83
St. Croix and Penobscot	....	....	3.00	....	....	....	11.25	....	....	....	14.25
Salem and Rutland	....	....	29.32	....	....	....	....	....	....	....	29.32
Shore Line	....	....	49.51	....	....	....	....	....	....	....	49 51
Sullivan County	....	0.52	....	....	....	....	....	....	....	....	0.52
Troy and Greenfield and Hoosac Tunnel	....	....	....	....	....	....	....	....	13.09	....	13.09
Vermont and Canada	8.00	17.70	....	....	....	....	....	....	....	....	25.70
Vermont and Massachusetts	8.24	....	....	....	....	....	....	....	....	....	8.24
Vermont Valley	....	23.61	....	....	....	....	....	....	....	....	23.6t
Wilton	....	15.43	....	....	....	....	....	....	....	....	15.43
GROUP II. NEW YORK, PENNSYLVANIA, OHIO, MICHIGAN, INDIANA, MARYLAND, DELAWARE, NEW JERSEY, DISTRICT OF COLUMBIA.											
Albany and Vermont	....	....	....	12.18	....	....	....	....	....	....	12.18
Allegheny Valley	....	....	....	....	....	....	44.00	....	....	....	44.00
Avon, Geneseo and Mount Morris	....	....	....	....	....	....	....	....	....	17.56	17.56
Baltimore and Ohio	....	54.00	71.00	82.50	....	....	....	....	....	....	207.50
Barclay Coal Company	....	....	....	....	....	....	16.23	....	....	....	16 23
Bellefonte and Snow Shoe	....	....	....	....	....	....	....	....	....	21.40	21.40
Belvidere-Delaware	....	15.79	....	25.81	8.73	13.92	....	....	....	....	64.25
Buffalo, New York and Erie	....	....	....	....	....	....	....	....	139.95	....	139.95
Canada and Atlantic	....	....	....	16.50	43.50	....	....	....	....	....	60.00
Catasauqua and Fogelsville	....	....	....	....	....	....	....	9.00	....	3.00	12.00
Catawissa	....	....	....	....	63.00	....	....	....	....	....	63.00
Central, of New Jersey	....	....	60.80	3.00	....	....	....	....	....	....	63.80
Central Ohio	....	....	....	....	137.29	....	....	....	....	....	137.29
Champlain and St. Lawrence	....	1.21	....	....	....	....	....	....	....	....	1.21
Chester Valley	....	....	....	21.52	....	....	....	....	....	....	21.52
Chestnut Hill	....	....	....	4.13	....	....	....	....	....	....	4.13
Chicago, Cincinnati and Louisville	....	....	....	....	30.00	....	....	....	....	....	30.00
Chicago, Detroit and Canada Grand Trunk Junction	....	....	....	....	....	....	....	....	....	59.25	59.25
Cincinnati, Hamilton and Dayton	....	59.88	....	....	....	....	....	....	....	....	59.88

Corporation.	Miles of railroad built, 1850–59. 1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	Decade.
Cincinnati, Hamilton and Indianapolis	....	....	....	....	....	....	....	....	....	14.00	14 00
Cincinnati, Indianapolis, St. Louis and Chicago	....	....	63.50	89.00	....	....	....	....	....	....	152.50
Cincinnati and Muskingum Valley	....	....	....	....	....	....	....	132.15	....	....	132.15
Cincinnati, Richmond and Chicago	....	....	24.80	11.20	....	....	....	....	....	....	36 00
Cleveland, Columbus, Cincinnati and Indianapolis	....	138.00	....	252.95	....	....	....	....	....	....	390.95
Cleveland and Mahoning Valley	....	....	....	....	....	....	67.46	....	....	....	67.46
Cleveland, Mount Vernon and Delaware	....	....	13.26	....	48.12	....	....	....	....	....	61.38
Cleveland and Pittsburgh	....	38.00	38.00	31.00	25.02	....	65.64	....	....	....	197.66
Columbus, Chicago and Indiana Central	47.00	....	36.00	....	21.00	67.10	....	49.00	106.20	74.00	400 30
Columbus, Springfield and Cincinnati	....	....	....	....	20.00	....	....	....	....	....	20 00
Cornwall	....	....	....	....	8.07	....	....	....	....	....	8 07
Cumberland and Pennsylvania	....	....	4.82	8.19	....	....	....	10.91	4 66	....	28.58
Dayton and Michigan	....	....	....	....	....	....	....	70.20	69.60	....	139.80
Dayton and Union	....	....	31.74	....	....	....	....	....	....	....	31.74
Dayton and Western	....	....	....	37.23	....	....	....	....	....	....	37.23
Dayton, Xenia and Belpre	....	....	....	....	16.00	....	....	....	....	....	16.00
Delaware	....	....	....	....	....	....	....	70.83	....	13.00	83.83
Delaware, Lackawanna and Western	....	50.75	....	80.00	....	....	69.25	....	....	....	200.00
Detroit, Grand Haven and Milwaukee	....	....	....	....	....	25.00	28.00	....	110.25	....	163.25
Detroit, Monroe and Toledo	....	....	....	....	....	....	37.21	21.87	....	....	59.08
East Pennsylvania	....	....	....	....	....	....	....	....	36.00	....	36.00
Elmira, Jefferson and Canandaigua	....	46.60	....	....	....	....	....	....	....	....	46.60
Elmira and Williamsport	....	....	....	....	52 50	....	....	....	....	....	52.50
Evansville and Terre Haute	....	....	27.18	24.41	57.41	....	....	....	....	....	109.00
Fairland, Franklin and Martinsville	....	....	....	26.30	....	....	....	....	....	....	26.30
Fall Brook Coal Company	....	....	....	....	....	....	....	....	....	6.09	6.09
Fayette County	....	....	....	....	....	....	....	11.80	....	....	11.80
Flemington Railroad and Transportation Company	....	....	....	....	11.67	....	....	....	....	....	11.67
Flushing, North Shore and Central	....	....	....	....	7.85	....	....	....	....	....	7.85
Freehold and Jamesburg Agricultural	....	....	....	11.44	....	....	....	....	....	....	11.41
Hanover Junction, Hanover and Gettysburg	....	....	13.00	....	....	....	....	17.00	....	....	30.00
Harrisburg, Portsmouth, Mt. Joy and Lancaster	18.13	....	....	....	....	....	....	....	....	....	18.13
Huntingdon and Broad Top Mountain R. R. and Coal Co.	....	....	....	....	....	24.10	6.00	8.30	1.30	3.25	42.95
Indianapolis, Peru and Chicago	22.00	....	....	....	50.87	....	....	....	....	....	72.87
Iron	13.00	....	....	....	....	....	....	....	....	....	13.00
Jackson, Lansing and Saginaw	....	....	....	....	....	....	....	....	12.55	6.30	18.85
Jeffersonville, Madison and Indianapolis	....	....	40.31	23.86	....	....	....	....	....	....	64.17
Junction and Breakwater	....	....	....	....	....	....	....	....	9.00	....	9.00
Kalamazoo and White Pigeon	....	....	3.80	....	....	7 50	....	....	....	....	11.30
Lake Erie and Western	....	....	....	....	....	....	36.50	....	...	....	36.50
Laka Shore and Michigan Southern	22 51	69.26	269.60	136.67	....	65.13	5.72	151.46	....	....	720 35
Lehigh Valley	....	....	....	....	....	46.00	2.00	....	....	....	48.00
Little Saw Mill Run	....	....	....	3.00	....	....	....	....	....	....	3 00
Little Schuylkill Navigation Railroad and Coal Company	....	....	....	....	8.10	....	....	....	....	...	8.10
Littles Town	....	....	....	....	....	....	....	....	7.00	....	7.00
Long Island	....	....	....	....	4.00	....	....	....	....	....	4.00
Louisville, New Albany and Chicago	....	35.20	252.80	....	....	....	....	....	....	....	288.00
Marietta and Cincinnati	....	....	....	37.40	57.30	55.30	60.00	41.00	7.30	....	258.30
Marquette, Houghton and Ontonagon	....	....	....	....	....	....	....	15.00	1.87	....	16.87
Michigan Central	9.35	....	42.65	....	....	....	....	....	....	....	52.00
Mill Creek and Mine Hill Navigation and Railroad Co.	....	....	....	....	3.47	....	....	....	....	....	3.47
Millstone and New Brunswick	....	....	....	6.14	....	....	....	....	....	....	6.14
Mine Hill and Schuylkill Haven	2.50	....	2.80	....	14.00	....	4.00	2.70	....	4.00	30.00
Morris and Essex	....	....	....	18.46	....	....	....	....	....	....	18.46
Newark and Bloomfield	....	....	....	....	....	3.69	0.56	....	....	....	4.25
New York and Canada	....	....	23.00	....	....	....	....	....	....	....	23.00
New York Central and Hudson River	74.47	70.00	18.00	80.75	....	....	....	....	....	....	243.22
New York and Flushing	....	....	....	....	....	....	....	....	....	4.30	4.30
New York and Harlem	....	....	50.50	....	....	....	....	....	....	....	50.50
New York, Lake Erie and Western	77.29	129.16	59.85	....	....	....	....	....	....	....	266.30
Niagara Bridge and Canandaigua	....	....	....	98.46	....	....	....	....	....	....	98.46
North Pennsylvania	....	....	....	....	....	....	10.10	57.50	....	....	67.60
Northern (of New Jersey)	....	....	....	....	....	....	....	....	....	21.28	21.28
Northern Central	....	27.00	....	....	....	....	....	....	53.05	....	80.05
Ogdensburg and Lake Champlain	117.48	....	....	....	....	....	....	....	....	....	117.48
Ohio and Mississippi	....	....	....	....	29.00	204.63	....	104.42	....	....	338.05
Pennsylvania	87.80	56 80	26.00	....	28.51	16.11	....	....	....	....	215.22
Philadelphia and Baltimore Central	....	....	....	....	....	....	....	....	9.00	....	9.00
Philadelphia and Erie	....	....	....	....	28.00	12.00	....	....	....	106.00	146.00
Philadelphia and Reading	....	....	....	....	53.40	....	....	....	53.70	....	107.10
Philadelphia, Wilmington and Baltimore	....	....	....	....	4.76	....	....	....	....	....	4.76
Pittsburgh, Cincinnati and St. Louis	....	....	....	....	7.80	116.62	....	....	....	....	124.42
Pittsburgh and Connellaville	....	....	....	....	....	....	24.70	....	....	....	24.70
Pittsburgh, Fort Wayne and Chicago	....	....	....	188.00	131.32	....	65.00	1.00	83.00	....	468.32
Rensselaer and Saratoga	6.83	18.97	15.65	....	....	....	....	....	....	....	41.45
Richmond and Miami	....	....	....	7.19	....	....	....	....	....	....	7.19
Rochester and Genessee Valley	....	....	....	....	....	....	....	....	....	18.26	18.26
Rome, Watertown and Ogdensburg	18.21	52.21	25.34	....	....	30.00	24.60	21.50	....	....	171.86
Schuylkill Valley Navigation and Railroad Company	....	....	....	....	....	....	4.00	....	....	....	4.00
Shamokin Valley and Pottsville	....	....	....	18.73	10.89	....	....	....	....	....	29.62
Shelby and Rush	18.33	....	....	....	....	....	....	....	....	....	18.33
Strasburg	....	4.25	....	....	....	....	....	....	....	....	4.25
Sussex	....	....	....	....	30.40	....	....	....	....	....	30.40
Syracuse, Binghamton and New York	....	....	....	....	81.00	....	....	....	....	....	81.00

Corporation.	Miles of railroad built, 1850–59. 1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	Decade.
Terre Haute and Indianapolis	....	....	72.50	....	....	....	....	....	....	....	72.50
Tioga	....	....	....	4.00	....	....	....	....	....	....	4.00
Troy and Bennington	....	....	5.38	....	....	....	....	....	....	....	5.38
Troy and Boston	....	....	34.74	....	....	....	....	....	....	....	34.74
Troy Union	....	....	....	....	2.14	....	....	....	....	....	2.14
Union, of Indianapolis	....	....	....	3.23	....	....	....	....	....	....	3.23
Utica and Black River	....	....	....	16.00	18.75	....	....	....	....	....	34.75
Warren	....	....	....	....	....	....	18.25	....	....	....	18.25
West Chester and Philadelphia	....	....	....	....	13.00	4.00	....	....	9.30	....	26.30
West Jersey	....	....	....	....	....	....	....	....	17.57	....	17.57
Western Maryland	....	....	....	....	....	....	....	....	1.60	7.90	9.50
Western Pennsylvania	....	....	....	24.00	....	....	....	....	....	....	24.00
Wheeling, Pittsburgh and Baltimore	....	....	....	32.00	....	....	....	....	....	....	32.00
GROUP III. VIRGINIA, WEST VIRGINIA, KENTUCKY, TENNESSEE, MISSISSIPPI, ALABAMA, GEORGIA, FLORIDA, NORTH CAROLINA, SOUTH CAROLINA.											
Alabama Central	....	....	....	....	....	....	16.00	....	14.00	....	30.00
Alexandria and Washington	....	....	....	....	....	....	4.96	....	....	....	4.96
Atlantic and West Point	10.00	23.00	25.00	21.67	....	....	....	....	....	....	79.67
Atlantic, Gulf and West India Railroad and Transit Co.	....	....	....	....	....	5.00	22.00	20.00	26 00	73.00	146.00
Atlantic, Mississippi and Ohio	....	....	106.91	75.94	86.08	21.07	56.74	45.34	36 28	....	428.36
Atlantic and North Carolina	....	....	....	....	....	....	....	33 00	62.00	....	95.00
Blue Ridge	....	....	....	53.00	....	....	....	....	....	....	53.00
Brighthope	....	....	....	....	....	....	....	....	....	32.50	32.50
Cape Fear and Yadkin Valley	....	....	....	....	....	....	....	....	....	12.00	12.00
Carolina Central	....	....	....	....	50.00	....	60.00	50.00	....	28.00	188 00
Central Railroad and Banking Company, of Georgia	....	....	17.00	....	....	....	....	....	....	....	17.00
Charlotte, Columbia and Augusta	....	....	106.40	....	....	....	....	....	....	....	106.40
Cheraw and Darlington	....	....	....	....	18.00	22.00	....	....	....	....	40.00
Chesapeake and Ohio	21.00	27.54	10.45	....	29 12	32.06	7.07	19.56	....	....	146.80
Chester and Lenoir, N. G.	....	....	23.09	....	....	....	....	....	....	....	23.09
Chicago, St. Louis and New Orleans	....	....	....	....	....	....	....	....	207.20	234.80	442.00
East Tennessee, Virginia and Georgia	....	....	....	42.00	55.00	89.00	56.00	....	28.00	....	270.00
Eatonton Branch	....	....	....	21.00	....	....	....	....	....	....	21.00
Florida Central	....	....	....	....	....	....	....	....	....	59.50	59.50
Georgia Railroad and Banking Company	....	....	....	18.00	....	....	....	....	....	....	18 00
Grand Gulf and Port Gibson	....	....	....	....	7.50	....	....	....	....	....	7.50
Greenville and Columbia	45.00	....	....	50.00	11.50	....	9.50	....	....	....	116.00
Jacksonville, Pensacola and Mobile	....	....	....	....	....	....	....	27.00	....	....	27.00
Kentucky Central	....	....	....	....	80.00	....	....	....	....	....	80.00
Laurens	....	....	....	....	31.04	....	....	....	....	....	31.04
Lexington and Big Sandy	....	....	....	....	....	....	....	....	....	16.93	16.93
Louisville, Cincinnati and Lexington	....	65.20	....	....	....	....	....	....	....	....	65.20
Louisville and Nashville	....	....	....	....	....	....	....	37 30	....	185.23	222.53
Maysville and Lexington (Southern division)	....	....	....	....	19.00	....	....	....	....	....	19.00
Memphis and Charleston	43.00	49.00	....	44.00	52.00	....	60.00	42.00	....	....	290.00
Mississippi and Tennessee	....	....	....	....	....	12.00	10.00	37.00	....	6.07	65.07
Mobile and Girard	....	....	....	....	....	20.00	4.00	22.00	4.00	5.00	55.00
Mobile and Ohio	....	....	33.00	....	63.50	56.50	44.50	34.50	86.50	29.00	347.50
Nashville, Chattanooga and St. Louis	....	....	....	....	159 00	....	35.00	....	....	40.00	234.00
Nashville and Decatur	....	....	....	....	....	....	....	....	....	119.09	119.09
North Carolina	90.00	....	41.15	....	....	....	....	....	....	....	131.15
North-eastern, of South Carolina	....	....	....	....	....	....	....	102.00	....	....	102.00
Parkersburg Branch	....	....	....	....	....	....	....	103.50	....	....	103.50
Raleigh and Augusta Air Line	....	....	....	....	42.00	....	....	....	....	....	42.00
Richmond and Danville	14.35	31.67	30.28	11.55	10.40	32.70	13.70	....	....	....	144.65
Rogersville and Jefferson	....	....	....	....	....	....	....	....	....	11.73	11.73
Selma and Greensborough	....	....	....	....	....	13.39	....	....	....	....	13.39
Selma, Rome and Dalton	....	....	9.00	13.00	9.00	24.00	17 00	17.00	10.00	10.00	109.00
South-western, of Georgia	....	50.50	....	21.00	21.00	....	....	35.50	....	35.50	163.50
Spartanburg, Union and Columbia	....	....	....	....	....	....	....	....	68.00	....	68.00
Tennessee Coal and Railroad Company	....	....	....	....	....	10 00	....	8.00	....	....	18.00
Upson County	....	....	....	....	....	....	....	16.00	....	....	16.00
Vicksburg and Meridian	15.00	....	....	....	....	....	....	....	....	....	15.00
Washington City, Virginia Midland and Great Southern	....	....	....	....	160.20	....	....	....	....	61.00	221.20
Western and Atlantic	138.00	....	....	....	....	....	....	....	....	....	138.20
Washington and Ohio	....	....	....	....	149.00	....	....	....	....	....	149.00
GROUP IV. ILLINOIS, IOWA, WISCONSIN, MISSOURI, MINNESOTA.											
Chicago and Alton	....	....	70.10	....	150.00	....	....	....	....	....	220.10
Chicago, Burlington and Quincy	....	12.02	....	....	165.60	152.30	....	....	....	75.90	405.82
Chicago, Iowa and Nebraska	....	....	....	....	....	....	....	....	82.40	....	82.40
Chicago and Milwaukee	....	....	....	....	....	85.00	....	....	....	....	85.00
Chicago, Milwaukee and St. Paul	10.10	24.00	27.00	18.10	23.60	88.40	138.30	232.08	104 29	....	665.77
Chicago and North-western	....	....	50.00	48.10	135.50	91.30	30.00	....	....	74 00	428.90
Chicago, Rock Island and Pacific	....	....	....	....	182.25	....	67.00	....	....	37.00	286.25
Dubuque and Sioux City	....	....	....	....	....	....	....	....	80.00	....	80.00
Elgin and State Line	....	....	....	....	36.34	....	....	....	....	....	36.34
Hannibal and St. Joseph	....	....	....	....	....	....	30.00	98.77	46.45	31.19	206.41
Illinois Central	....	....	14.00	117.00	294.75	202.47	77.28	....	....	....	705.50
Joliet and Chicago	....	....	....	....	....	....	....	....	37.20	....	37.20
Joliet and Northern Indiana	....	....	....	....	....	45.00	....	....	....	....	45.00
Keokuk and Des Moines	....	....	....	....	....	....	....	39.20	....	....	39.20
Mineral Point	....	....	....	....	....	....	....	33.00	....	....	33.00



BRIDGE OF COLUMBIA AND PHILADELPHIA RAILROAD OVER THE SCHUYLKILL RIVER

Corporation.	Miles of railroad built, 1850–59. 1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	Decade.
Missouri Pacific	....	....	4.75	32.25	....	44.00	44.00	....	41.25	5.00	171.25
Peoria and Bureau Valley	....	....	....	....	46.72	....	....	....	....	....	46.72
Peoria, Pekin and Jacksonville	....	....	....	....	....	....	....	....	....	58.15	58.15
Rock Island and Peoria	....	....	....	....	....	....	....	11.50	....	....	11.50
St. Louis, Alton and Terre Haute	....	....	....	....	80.00	106.00	21.00	....	....	....	207.00
St. Louis, Iron Mountain and Southern	....	....	....	....	....	....	....	....	89.69	....	89.69
St. Louis and San Francisco	....	....	....	....	....	....	....	....	19.00	....	19.00
Sheboygan and Western	....	....	....	....	....	....	....	....	....	13 90	13.90
Sycamore, Cortland and Chicago	....	....	....	....	....	....	....	....	....	4.90	4.90
Toledo, Peoria and Warsaw	....	....	....	....	....	16.90	15.70	53.60	11.50	....	97 70
Wabash, St. Louis and Pacific	....	....	....	....	....	383.50	....	60.75	64.00	22.75	531.00
GROUP V. LOUISIANA, ARKANSAS, INDIAN TERRITORY.											
Clinton and Port Hudson	....	....	....	....	....	....	0.75	....	....	....	0.75
Morgan's Louisiana and Texas Railroad and Steamship Co.	....	....	....	32.00	2.00	48.00	....	....	....	....	82.00
Vicksburg, Shreveport and Pacific	....	....	....	...	....	....	....	....	18.00	....	18.00
GROUP VI. DAKOTA, NEBRASKA, KANSAS, TEXAS, NEW MEXICO, CALIFORNIA, &c.											
Houston and Texas Central	....	....	....	....	....	....	26.29	10.00	15.30	41.19	92.78
Sacramento and Placerville	....	....	....	....	....	....	21.90	....	....	....	21.90

THE FIRST RAILWAY PANICS.

THREE of the most direct results of the enormous additions to railway mileage during the sixth decade were two panics, the creation of permanent incitements to competition between rail and water carriers and rival rail routes for nearly all important classes of the traffic of the Mississippi valley and various other sections, and an immense increase of the value of the land and the agricultural products of the great west and north-west. These outgrowths are each of so much importance that they will be discussed under separate headings, the first of which relates to the

FINANCIAL DIFFICULTIES.

To fully comprehend the extent of the drain upon resources made by the additions to mileage, it is necessary to remember that the cost of construction, according to the census report of 1860, increased in the New England states from $97,254,201 in 1850 to $148,366,514 in 1860; in the Middle Atlantic states, from $130,350,170 to $329,528,231; in the Southern Atlantic states, from $36,875,456 to $141,739,629; in the Gulf states, from $5,286,209 to $64,943,746; in the interior Southern states, from $1,830,541 to $49,761,199, and in the northern interior states, including Ohio, Indiana, Michigan, Illinois, Wisconsin, Iowa, and Missouri, from $25,063,571 to $413,541,510. Ohio, which had 575.27 miles of railroad, that had cost $10,684,000, in 1850, had 2,999.45 miles, that had cost $111,896,351, in 1860. Illinois, that had 110.50 miles, costing $1,440,507, in 1850, had 2,867.90 miles, that cost $104,944,561, in 1860. Missouri, which had no railways in 1850, had commenced operations by constructing 817.45 miles, at a cost of $42,342,812. Tennessee, which reported no mileage in 1850, had closely followed the example of Missouri, by constructing 1,197.92 miles, at a cost of $29,537,722, and Virginia had increased her mileage and railway outlays from 515.15 miles, costing $12,585,312, in 1850, to $64,958,807 in 1860. In several of the Southern states, and notably Virginia and Tennessee, many of the lines were liberally aided by loans of state credit or bonds, and large debts were thus incurred, which have been fruitful causes of acrimonious disputes between unsatisfied creditors or bondholders and taxpayers or state governments ever since. In Tennessee during the sixth decade, while the state outlays were being made, very impressive assurances were given that they would create no financial difficulties, because the state only provided means for furnishing the iron rails and superstructure of roads graded by private capital. In some of the other commonwealths numerous towns, cities, and counties pledged their credit to support new enterprises, and learned, to their sorrow, how much easier it was to run into debt than to pay interest on the cost of unremunerative securities, and the cases were not infrequent in which these grants of local credit were obtained by questionable means or shamefully abused.

The two panics of the decade may, perhaps, justly be considered a twin convulsion, the first being the shock of 1854 and the second the shock of 1857. They were both caused largely by revulsions in railway affairs, and the confusion or derangements arising from the sudden engulfment of vast sums of money in new and temporarily unprofitable lines. There had been panics before, and much more serious ones, some of which were attributable partly to a collapse of state credit originating in large appropriations for internal improvements, but the checks of the sixth decade were the first produced by the operations of railway companies; and a noticeable feature of the industrial history of the period is the extent to which the amount of construction in each year was affected by the fluctuating financial tendencies.

While the number of miles of railroad in operation, according to the census report of 1880, was 7,310.44 at the end of 1849, and 27,470.97 at the end of 1859,—an increase of 20,109.63 miles, or at the rate of nearly 2,011 miles per annum, there was a great variation in the number of miles built in each year, the culminating period being 1854, or the year of the first railway panic. The number of miles built in each year of the sixth decade was as follows: 1850, 1,261.04 miles; 1851, 1,274.46; 1852, 2,288.44; 1853, 2,169.62; 1854, 3,442.16; 1855, 2,452.83; 1856, 1,470.87; 1857, 2,077.04; 1858, 1,966.05; 1859, 1,707.12. It will be seen that, reversing the natural order of things, more than twice as many miles were built in the fifth year of the decade, or 1854, as in the tenth, or 1859.

THEORIES OF THE CAUSES OF THE PANICS.

Something had evidently happened to check the onward march of the projectors, engineers, graders, and contractors.

The following reference to the causes and nature of the panic of 1854 was made in the Pennsylvania Railroad report of 1855:—

"Unavoidable delays in procuring legislative authority to increase the loans of the company, prevented the board from presenting to capitalists their second mortgage bond (issued to meet the demands for the second track and increased equipment), until hostilities in eastern Europe had assumed an aspect so serious that the capitalists of England—where our bonds had been chiefly disposed of heretofore—became alarmed, and declined for a time to invest further in American railroad and municipal securities on terms that were deemed satisfactory on this side. . . . It is admitted that the existing embarrassments in financial and commercial affairs are largely due to the excessive expansions of credit throughout the Union in the various forms it assumes in the active business transactions of life. It is believed, however, that but for the crises referred to—aggravated as they have been by the frauds that have occurred in the management of some of the eastern railroads—no serious disturbance of confidence would have taken place until a later period. Although to some extent sufferers from the difficulties attending this condition of the money market, we cannot but feel satisfied that the general good will in the end be advanced by the timely check placed upon many of the wild schemes of improvement that had been commenced and were maturing throughout the west, as well as in our own state. It is hoped that the lessons of the past will be a warning to capitalists to use greater discrimination in future in the investment of the means with which fortune has favored them."

The President of the United States, Franklin Pierce, in his annual message dated December 4th, 1854, referred to the same subject, in connection with a protest against land-grant legislation, which had been greatly stimulated by the interest excited in and rapid progress made by the Illinois Central. He said that "the applications at the last session contemplated the construction of more than five thousand miles of road, and grants to the amount of nearly twenty millions of acres of the public domain. Even admitting the right of Congress to be unquestionable, is it quite clear that the proposed grants would be productive of good, and not evil? The different projects are confined, for the present, to eleven states of this Union, and one territory. The reasons assigned for the grants show that it is proposed to put the works speedily in process of construction. When we reflect that since the commencement of railways in the United States, stimulated, as they have been, by the large dividends realized from the earlier works, they are the great thoroughfares, and between the most important points of commerce and population, encouraged by state legislation, and pressed forward by the amazing energy of private enterprise, only seventeen thousand miles (at the end of 1854) have been completed in all the states in a quarter of a century; when we see the crippled condition of many works, commenced and prosecuted upon what were deemed to be sound principles and safe calculations; when we contemplate the enormous absorption of capital withdrawn from the ordinary channels of business, and extravagant rates of interest at this moment paid to continue operations, the bankruptcies not merely in money, but in character, and the inevitable effect upon finances generally, can it be doubted that the tendency is to run to excess in this matter? Is it wise to augment this excess by encouraging hopes of sudden wealth expected to flow from magnificent schemes dependent upon the action of Congress? Is it not the better rule to leave all these works to private enterprise, regulated and, when expedient, aided by the co-operation of states? If constructed by private capital, the stimulant and the check go together, and furnish a salutary restraint against speculative schemes and extravagance."

The following brief reference to the panic of 1857, at its outset, was published in the American Engineer, of August 29th, 1857:—

"The financial world is in the midst of a panic. There have been a portentous number of failures. Erie stock (a gauge for most fancy stocks) has touched 20—the banks are hauling in, and the large grain crop being sent forward does not promise either ready sales or high prices. The largest part of this condition has been owing to the simple delusion that railroads could be worked for 50 per cent. of their gross receipts—or, in other words, overlooking depreciation. There are one thousand million dollars invested in railroads in the United States, and where it has been believed that this property could pay $70,000,000 yearly, it does not pay $40,000,000—a yearly deficit of more than $30,000,000. This is a good deal of money to be wasted yearly, but the country, if it does not plunge still deeper in debt, will soon outgrow it. The present panic will not exist a great while, although money will be 'tight' all winter."

The annual message of President Buchanan, sent to Congress in December, 1857, in referring to the panic of that year, attributes it largely to an unsound banking system, and the encouragement it afforded to speculating schemes and stock gambling. In describing the nature of the disturbance he says: "Up till within a brief period, our manufacturing, mineral, and mechanical operations have partaken largely of the general prosperity. We have possessed all the elements of material wealth in rich abundance, and yet, notwithstanding all these advantages, our country, in its monetary interests, is at the present moment in a deplorable condition. In the midst of unsurpassed plenty in all the productions of agriculture, and in all the elements of national wealth, we find our manufactures suspended, our public works retarded, our private enterprises of different kinds abandoned, and thousands of useful laborers thrown out of employment and reduced to want."

To some extent, the extracts given above represent four theories in regard to the causes and nature of the first railway panics. These theories each refer to some of the most obvious or plausible reasons for the misfortunes which befell the country, but neither describes at length the influences that had been gradually undermining confidence in railway securities. Probably the suggestions contained in the reference to this subject, in the Pennsylvania Railroad report, attributing the first difficulty to the counter drain of European capital, caused by the Crimean war, and stating that capitalists should use greater discrimination in their railway investments, come nearest to depicting the most potent causes of the panics. There is at many periods a tendency to rush into extremes, one era being characterized by such overweening confidence that almost anything styled a railway bond can readily be sold at something near its par value, and another by such excessive distrust that it is almost impossible for the richest railway companies to obtain meagre financial accommodation. Subsequent experience has shown that railway panics may occur even under the soundest banking system yet devised, and while the country is teeming with wealth. But there is little doubt that the panics of 1854 and 1857 were aggravated by the character of the state banking systems then existing, and perhaps still less doubt that the practice of building speculative railways, which was either inaugurated, or at least greatly extended, during the sixth decade, did much to engender distrust.

As American credit was rapidly rising, on account of the extraordinary growth of the country, the rich yield of the California gold mines, the marked increase of productive power of all descriptions, the foundation of great settlements on the Pacific coast, immense addition to the population of the western and north-western commonwealths, the restoration of the credit of nearly all the states, and the material improvement of banking systems, very active efforts to dispose of enormous issues of railway bonds were made. In a large majority of cases the purchasers of these bonds made very good bargains, as they bought at prices ranging from ten to twenty per cent. below par, securities that paid from six to seven per cent. on their face value, and the better classes of the corporations that contracted these loans established a sound basis of credit by large and judicious actual outlays of money obtained from stockholders or appropriations or subscriptions of solvent cities, counties, and states. The bulk of these securities were not seriously affected in intrinsic value even by the panics, as the worst thing that happened to investors in them, was a postponement of a few interest payments.

SPECULATIVE CONSTRUCTION.

But the tendency to diminish the proportion that actual payments on capital stock bore to floating and bonded indebtedness was rapidly strengthened during the sixth decade, and throughout the entire history of railway financiering it has probably been this tendency more than any other that has caused corporate difficulties and engendered distrust, inasmuch as it involves the task of doing business almost exclusively on borrowed capital; the practice of incurring large floating debts while construction or improvements were progressing in the hope that bonds would be sold in time to meet short notes discounted by banks or note shavers, was resorted to on an extensive scale, even by a number of the best companies; and all the possibilities of financiering in connection with these expedients were in some instances grossly abused by unscrupulous speculators, and thus made sources of considerable loss to innocent investors.

The practice of soliciting the subscriptions of cities or counties to railway projects which had been resorted to at an earlier period in behalf of sound enterprises, began to be the source of so many evils that some of the states conceived it to be their duty to strictly prohibit such subscriptions, while in other states they continued to be still freely resorted to in every neighborhood unsupplied with railroads, especially in commonwealths in which free railroad laws had been enacted, giving the power to any small body of men to organize a railroad company; and this departure from the original practice of requiring special legislative authority for each new line began to be common, but not universal, during the sixth decade.

VARYING FINANCIAL METHODS AND MOTIVES FOR RAILWAY CONSTRUCTION.

In connection with projects intended to promote commercial objects and improve localities, there was a considerable period during which financial contributions for the construction of railways were made, sometimes by individuals, as well as cities, counties, or states, which were scarcely expected to yield direct money returns, in the shape of interest or dividends. The sentiment which prompted such action was forcibly expressed by one of the daily journals advocating it, during the sixth decade, in this appeal: "Railroads now ramify all parts of our country. Their history is that of our national greatness, and individual wealth and happiness. They have been the great pioneers of civilization. They have overcome distance. They have linked distant communities in the golden chain of identity. They have spread the light of learning as from a radiant sun. They have added terrors to our armies. They have made peace more peaceful. With them hours are but moments, and miles but imperceptible lines. The mighty weights which break the sinews of beasts of burden are to them but bubbles sporting on the billows of strength. They perform for us the labor of millions of men, and the cry of weariness comes not from their iron mouths as they thunder along the plain, leap across the river, roll over the hill, or dart through the mountain.

It is a question worthy of consideration whether railroads should ever be built with a view of dividends among stockholders. They should be constructed as great national enterprises, from which individual benefits are to arise from the increased value of the lands through which they pass, and the advantages of speedy communication with different parts of the country. The farmer who owns a hundred acres of land through which a railroad is to pass, and values it at $2,500, may well afford to take stock in the road to the amount of $1,000, simply because the value of his land will increase more than this sum. But should he expect dividends from this road? Has he not been paid back his $1,000 in the increased value of his property? May not the same thing be said of the merchant who has gotten back what he paid for his stock in the increased sales to customers brought to him by railroad communication?"

It is evident, however, that the desire to secure returns for money advanced, was one of the most powerful incentives to financial supporters of the railways of all decades, and it was on this basis, rather than any other, that they were constructed.

FINANCIAL ARRANGEMENTS FOR LEGITIMATE RAILROADS IN THE EARLY PART OF THE SIXTH DECADE.

A contemporaneous description, in Colburn's Railroad Advocate, after explaining the impossibility of obtaining all the money needed for construction from stock subscriptions, and stating that its remarks apply to legitimate roads, and not to wild-catting enterprises, says:—

"The estimated cost of the road is perhaps $31,127.22½ per mile (a very precise sum indeed); and if the road be a hundred miles long, its cost, of course, will be $3,112,722.50 (exactly). The directors have resolved, probably, to issue stock to the amount of $1,500,000. They offer as much for subscription among the crowd. One man strains his cash account for $5,000, and another trusts to his crops to shell out $600. Another calculates on a speculation with some unimproved real estate then on his hands, and confidently chalks down $15,000. Safe men sign their names for $1,000 each, and after much drumming the stock list becomes pretty full. There are always a few widows and orphans who will venture to the tune of $100, $300, $700, and so on, being told the 'railroad is as good as a bank.'

Well, perhaps $1,302,400 have been subscribed. All this must draw interest when paid in, until the road is built and at work. Meanwhile a few subscribers flunk out, and their stock is forfeited, and sold at auction. The sacrifice is not much, though, and perhaps the installments paid in, if any, will cover it.

But while the installments are coming in, and the work is going on, it is found that the engineer let in some ugly grades and some pokerish curves, just to save cost of construction. A sort of semi-professional and semi-proprietary consultation is held, and the ugly grades and pokerish curves are set aside forthwith. The contractors are mollified, and all hands determine to build a first-rate road, and no mistake. Meanwhile the construction account expands thermometrically in the heat of the zeal for a good road.

We might have said, as we have already introduced the contractors, that perhaps they did not take hold on the engineer's estimates, but staked one out for themselves, and got the job at their own figures. But if the company is not $250,000 out for all these little accidents, nobody need be troubled in spirit.

Now comes the next pull for cash. The road has lengthened out, in probable cost, to perhaps $3,500,000. The subscriptions have not netted, deducting forfeitures, collections, and interest, over $1,300,000, a part, perhaps, yet resting in the dim future.

A formal mortgage is accordingly executed on the whole line and deposited in trust with suitable parties. Upon this mortgage, as a security, the company come out to borrow money, payable in twenty or twenty-five years, and issue their bonds to represent the same. The bond simply expresses the obligation to repay the money, and binds the borrowers to the provisions of the mortgage in case of failure of repayment.

Each bond is for $1,000. It ordinarily draws 7 per cent. interest, payable semi-annually. Executed in full, the bonds are ready for sale. Who bids? One says 85, another 86,—the bonds go at 86. For $860 a bond for $1,000 is given up, and $70 interest obligation to be paid, equal to over 8 per cent. actual interest on the money lent on the bond.

The whole issue of bonds under the mortgage is, perhaps, $2,000,000. These 'net' at the selling rate $1,720,000, and deducting commissions, &c., say $1,640,000.

Thus, with money raised on stock, the whole cash basis is now $2,940,000, against which is a debt of $2,000,000,—and at least $550,000 are still required to complete the road.

When the time comes round for more money, a second mortgage, covering the whole road, but subject to the claim of the first mortgage, is executed. This is, perhaps, for $500,000, and nets $375,000. What is still wanted to complete the road is supplied, perhaps, by borrowing on notes, or the road is left uncompleted to that amount, or the earnings, above interest, are appropriated.

It is a blue time when poor lines, or lines covering unprofitable routes, get into this fix. But *per contra*—take a *good* road, and in five years' time its debt will be half converted into stock if there is a clause in the mortgage which allows it. Its yearly payments for interest will be reduced, its line completed from earnings, and its stock bearing 8 per cent. dividend, and selling in the market at 110."

TRANSITION TO "WILD-CAT" FINANCIERING OPERATIONS.

How free-railroad-law privileges were sometimes misused is shown in the following extract from an article in Colburn's Advocate, of October 27th, 1855:—

"Railroad building (not mechanically, but financially), has become a considerable profession. It is notorious that many a good road has been originally commenced merely as a means of acquiring a single fortune from mere 'operating.'

Let us see how a railroad may be built nearly entirely on credit, and to realize a ready net cash product to the builders.

It requires tact and address to obtain a town, county, or city subscription, payable in bonds, with twenty years to run; but the task is not difficult, anywhere, to men of cheek. Next a handsome subscription of improved real estate, at a round valuation, and a fair exertion will secure a show of cash subscriptions from impressible farmers. Here, then, is a basis for a loan, and custom has often sanctioned loans equal to two-thirds of the whole nominal security, or double the original nominal or actual basis.

Now, to this point, every step may be taken by men without means. Having established a project, they have then only to step into it as contractors, securing, as they may, liberal pay on consideration of taking stock and bonds. Now, by sustaining these securities at the highest possible price, the projector unloads at a paying figure, relieves himself of all liability and risk, and permits the concern to settle itself in the hands of the new parties who are suddenly found in it. The flush over, its stock quite often runs down from 20 to 50 per cent., and the road is found to be uncompleted, requiring fresh sacrifices on bonds and short paper to bring it into full working efficiency."

If all railway construction that had an element of speculation in it, had been prohibited from the outset, the mileage of the American system would fall far below its present proportions. We do not wish to be understood as condemning every enterprise that had a tinge, or even a deep tinge, of speculative support. But there is a wide distinction between roads that are manifestly intended to serve useful purposes, and that are constructed and capitalized at a rate which will probably secure a fair return to investors unless exceptionally disastrous conditions prevail, on the one hand, and roads which are projected, constructed, capitalized, and managed under conditions which render them little better than organized swindles, on the other hand. That the disastrous tendencies displayed in construction were sometimes supplemented with equally deplorable tendencies in management, during the sixth decade, is indicated by the following extract from an article styled a "Picture of Railroad Management," which was published in Colburn's Railroad Advocate, of July 5th, 1856:—

"Before the company had spent their money, and when they were consequently flush, they dispatched an agent to a rolling mill in the interior to contract for their iron. This agent, lest he should see the company's funds wasted, very wisely put their bonds, to the full amount of the iron wanted, into the hands of the parties who contracted to supply the iron. Unfortunately, these gentlemen failed, and after getting a part of their iron, the railroad company took a mortgage on the mill, which, whenever the hour of foreclosure comes, will enable them to find the rest of their iron, if it is 'there.'

Fully impressed with the great value and future magnitude of their enterprise, the company bought from one of their directors, and on his *advice*, one hundred acres of land on the outskirts of the large town which was the principal terminus of their road. This land cost them $100,000. It was a regular goose pasture, unsuited to any possible wants of the road, and was just where the station and works of the company should *not* be. To this day it remains unbroken in its pristine loveliness, a pleasant resort for the porcine inhabitants of the neighborhood, and an accommodating receptacle of the wash from the surrounding hill-slopes.

The road, finally put in operation, terminates nowhere, being minus its western connection, of 25 miles, with the railroad system of the adjoining state. The stockholders and bondholders have delightful times in the agreeable society of each other, each vieing with the other in self-sacrificing devotion to the fortunes of the old concern. 'Beautiful in their lives, in death they shall not be separated.'"

FINANCIAL METHODS OF CONSTRUCTION IN 1859.

Of the financial methods sometimes adopted shortly before the close of the sixth decade Storr's Capitalists' Guide and Railway Annual for 1859 says:—

"The plan of constructing railroads with bonds to such an extent as has been practiced since 1854 should never have been permitted by stockholders, especially at a time when it was not difficult to find subscribers for stocks in all feasible enterprises. . . . The system of construction has been wrong from the beginning. If a company, with a nominal capital of $2,500,000, having 150 miles of road to build, with a cash subscription of $600,000, instead of completing and equipping 25 miles of road, it would put the whole line under contract at once, pledging the road and appurtenances for $1,800,000 in bonds, and depending upon contingencies for the remaining $1,400,000. The plan has been to pay the contractors in cash, say 25 per cent., bonds 50 per cent., and stock 25 per cent. The contractor was shrewd enough to obtain a sufficient margin to cover the most extravagant discount upon the securities of the company, while rails that would command but $45 cash per ton readily brought from $60 to $70 in railway bonds, and to convert these into money would require a discount of 25 to 30 per cent., because every capitalist throughout the country was full of them, and it was so in everything supplied to the company for construction. . . . Meantime the funds of the company are fast giving out. Another issue of bonds, based upon the expected income of the road, is manufactured, and given for work. After a struggle the rails are all laid, a light stock of equipment is furnished, but the company are unable to save anything from earnings, because the road is indifferently stocked and badly ballasted. The first year finds it with just enough money from traffic to pay running expenses, but saddled with a large floating debt, created by being short of means at the start, and subsequently promising to pay nearly double for everything. . . . This is no fancy sketch, but true with nearly one-half of the western roads built within the last three years. . . . The different classes of liabilities binding the same piece of property would be sure to end in disaster to one or more holders if it covered anything else but a railroad. . . . Out of a large number of reports which the compiler has had under review he has been unable to find more than about thirty roads whose construction accounts are closed. . . . In leaving this account open, managers of railways possess a license for expenditures for 'construction' oftentimes without increasing the facilities for traffic. In many instances the account serves to absorb a large number of improper charges, and to cover up extravagancies. . . . Taking the average seasons of crops, there is ample business for every well-located road in operation, and if the compensation charged by railways for transporting passengers and freight could rest upon a similar foundation for profits that stockholders realize in banking and insurance companies, the capital employed in railways would be remunerative and popular. Unfortunately, however, they have, in a great majority of cases in this country, proven failures."

FREE RAILROAD LAWS.

The free railroad laws, passed in or about 1850 in New York and Ohio, and speedily adopted by a number of other states, made a radical change in many of the conditions affecting railway construction. Before that time a specific check existed on each proposed project, as it required legislative sanction; and an important consideration, in connection with the grant of any charter, was whether any or all of the interests of the state to be traversed would be injured or advanced. The disposition to jealously guard state interests was frequently illustrated by refusals to incorporate companies which were considered rivals by older lines, or likely to afford facilities for diverting trade to adjacent commonwealths. Pennsylvania was made the scene of important struggles of the kind indicated. The spirit which formerly prevailed is illustrated by a report of the committee of the Pennsylvania senate, on roads, bridges, and inland navigation, on granting the Baltimore and Susquehanna Railroad Company the privilege of extending their railroad into the state of Pennsylvania, which was read on January 17th, 1829. It opposed the proposed grant, various reasons being assigned for the unfavorable action, but the principal grounds of objection are summed up in the following extract:—

"The case may be stated thus: The state of Pennsylvania has projected and is now carrying into execution an enlarged and comprehensive system of internal improvement, designed to furnish to its citizens the advantage of a cheap transportation and an easy access to market; *and to make its own city that market;* to foster its commerce, which, ever grateful, repays the favors conferred on it; and this great work, involving an immense expenditure, is to be constructed at the expense of the state; and it is asked of the legislature to give to a rival city the privilege of intersecting these great improvements at a point within its own territory, for the purpose of conducting the trade from Philadelphia to Baltimore, to enable that city to reap the benefits of the system of internal improvements executed at the expense of this state, and to deprive the state of the revenue derived from the trade of its own commercial city, and of the large amount of tolls which it is confidently anticipated will be derived from the great line of communication from Middletown to the city of Philadelphia. The city of Baltimore having refused to this state the right of intersecting within its territory a great line of communication *projected by that city, for the purpose of directing to it the trade of the Union,* most certainly can have no just cause of complaint, at the refusal of this state to give to that city the right of intersecting its great improvements within the territory of Pennsylvania for the avowed purpose of drawing to Baltimore the trade destined to be conducted to the city of Philadelphia."

As the Pennsylvania state system of public works had been injured, in some respects, by the refusal of the lines of adjacent states to permit advantageous connections, her legislature, for a considerable period, including action in 1845, refused to them opportunities for traversing portions of her soil on routes they wished to occupy. Roads proposed in the north-western portion of the state, which were intended to afford a continuous connection between the New York trunk lines and Ohio, were only authorized on condition that there should be a divergence in gauges which would necessitate a transfer of freight at or near Erie. But after an acrimonious struggle, which formed one of the most exciting of the early railway wars, these laws were repealed. Analogous contests occurred in other states; and under free railway systems, which enable any small body of men who can obtain the requisite capital to select any practicable route, without regard to the interests of older lines or other considerations affecting the welfare of particular cities or producing regions, railways assumed, to an increasing extent, the status of commercial enterprises or speculations, and lost, in a considerable degree, their original characteristics as special protectors and trade allies of the states which granted their charters. In effect, at the outset, legislatures had said to the railways, help the state or some of its sections, and we will help and protect you, even to the extent of granting pecuniary aid in your hour of difficulty, and certainly in the sense of not permitting rival lines to jeopardize your prosperity. After free railroad laws were passed, a new order of things prevailed. The commonwealths which adopted them thereby warned all companies concerned that they must look out for themselves; that they could not rely upon state protection against injurious rivalries; and that if they could strengthen their financial position by forming advantageous alliances with roads that traversed other sections of the country they would probably advance the interests of the stockholders by such proceedings. Speculative construction was also, of course, greatly facilitated by the ease with which charters giving the right of eminent domain, or power to acquire such real estate as might be necessary for tracks, stations, and depots, could be procured.

RAILROAD STATISTICS OF 1855.

INSTRUCTIVE illustrations of the nature of some of the changes that had been inaugurated in connection with railway expansions, and of the general condition of the American railway system, are furnished by a statement which forms part of the report of the Secretary of the Treasury for the year ending June 30th, 1856, entitled Railroad Statistics of the United States. It represents the first serious effort of the Federal Government at any other period than a census year to obtain and publish such information. It was perhaps due to the fact that the Secretary at that time was Hon. James Guthrie, of Louisville, whose active participation in the effort to construct leading Kentucky railways inspired a better comprehension of and a more lively interest in such subjects than has been shown by most of his successors.

Although some companies neglected or refused to make returns, which were intended to represent as clearly as possible the operations of the year 1855, efforts were made to supply all important deficiencies, and the statement is presumed to be approximately correct. The aggregates are as follows: Railway mileage completed, 19,936¼; miles unfinished, 16,069; amount of capital stock paid in, $433,286,946; amount of bonds issued, $303,137,973; amount of floating debt, $40,126,958; estimated cost when completed, $1,090,381,114; receipts, $91,182,693; working expenses, $48,712,381; net profits, $41,929,404; number of passengers carried (way and through), 30,826,450; number of passengers carried one mile, 1,113,871,493; tons of freight carried (way and through), 121,990,998; number of tons carried one mile, 3,401,526,452. The extent to which the railway capital invested was held abroad was estimated at $9,000,000 out of $433,286,946 of railway stocks, and $73,871,000 out of $303,137,973 of railway bonds, or about 2.08 per cent. of the stocks and about 24.34 per cent. of the bonds.

The Secretary of the Treasury, in referring to this subject, said that "the condition of the European money market during the recent war between Great Britain, France, and Russia, and since, has not been such as to afford a market for additional American stocks, whilst many of them have been returned to America and cashed."

UNFINISHED CONSTRUCTION.

Details of the tables and of the returns made by the respective companies embrace sundry facts bearing on the main topic of the causes of the panics.

One of the most important is, that although the railway system had then attained the considerable magnitude of 19,936¼ miles, the work unfinished and in process of construction so closely approached the finished lines that the aggregate was 16,069 miles. This relation necessarily implied the existence of a large amount of railway work that was temporarily unproductive, either because much grading had been done on projected roads that had not procured rails, or because the principal points which were expected to furnish traffic had not been reached, and when panics or unlooked-for financial difficulties thwart the efforts of companies which have reached such stages they are placed in the unfortunate position of being responsible for large outlays from which no immediate returns can be derived, and left in a state of fearful uncertainty as to when expensive but wholly unproductive deep cuts and high embankments can ever gain earning value.

TRANSITIONS TOWARDS LARGE INDEBTEDNESS.

Another cause of embarrassment was the extent to which a considerable number of lines had substituted or were substituting, for the practice which had previously been found safe, of deriving at least half the capital spent, and frequently a much larger proportion, from the money of stockholders actually paid in, the relatively new device of relying largely, if not principally, for pecuniary assistance upon money derived from the sale of bonds, or from the still more precarious practice of creating floating debts. The radical difference between these systems is closely akin to, if not substantially identical with, the difference between doing an extensive business that is subjected to serious vicissitudes with owned capital on the one hand, and borrowed capital on the other. Nearly all railway companies stand in need of large new advances of money, and the soundness of the various methods adopted, or nature of the securities issued to obtain it, may vary greatly with the peculiar circumstances of each case or class of cases. Thus with a land-grant road, known to possess much valuable real estate which can gradually be sold, it is by no means as necessary as in many other cases that the means derived from the sale of capital stock should approximately equal or exceed the sums procured by loans or the sale of bonds. There may be sundry other exceptions. But the general rule that doing business on borrowed capital involves risks of serious embarrassments during panic eras, and either frequently or continuously subjects stockholders to the penalty of dispensing with dividends, found many illustrations during the period under discussion, as at all subsequent stages of American railway development.

THE DIVIDEND PAYERS OF 1855.

Indications of the correctness of these observations are furnished by the list of roads that declared dividends in 1855 and the characteristics of their capital account in that year.

Generally speaking, all the earlier New England roads that had been built mainly with the capital procured from the stockholders paid dividends of from 4½ to 8 per cent., and usually from 6 to 7 per cent., and the railway capital of all the

New England states was represented by $94,474,291 of capital stock paid in, $46,522,689 of bonds issued, and $8,798,024 of floating debt. The favorable character of this exhibit was largely due to the specially large proportion of stock capital on the Massachusetts railways, amounting to $48,361,450, against $16,403,860 of bonds issued, and $3,976,425 of floating debt, but in each of the New England states capital stock represented a larger sum than bonds issued. In Maine, in which state bonds and floating debt combined slightly exceeded the stock capital, and in Vermont, in which the two classes of debts fell but little short of the amount of capital stock, the dividend-paying mileage was comparatively small, and in proportion to the territory covered the ground-work was laid for a tolerably extensive crop of non-dividend-paying railway stock.

New England did not wholly escape the disasters of the period. One was reflected in the statement of the Eastern, of Massachusetts, which had $2,853,400 of capital stock and $2,759,386.33 of debt. It reported "no dividend since 1854, formerly 8 per cent." This decline in profitableness was probably due largely to some of the early exemplifications of the usual effects of railway parallelism. Another disaster was the statement of the New York and New Haven Railroad Company that it had declared no dividends, "owing to the Schuyler over-issue of stock, now in suit." This was probably the fraud referred to by Mr. J. Edgar Thomson as one of the leading causes of the panic of 1854. Its perpetrator was a prominent New York railway official and speculator. In abusing his trust by the fraudulent issue of the stock of the company for his personal advantage, he inflicted one of the first great shocks on public confidence in railway management. It is a noticeable fact that although similar frauds have since occasionally occurred in connection with the issue of the stock of street railways or other small corporations, they have very rarely since been perpetrated by officers of important steam railway lines.

RAILWAYS OF THE MIDDLE STATES.

In the state of New York railway capital was represented by $66,775,053 of stock, $72,606,430 of bonds, and $4,994,058 of floating debt. A sum larger than the entire excess of the debt over the stock, in the state, was represented by the excess of that kind in the capital account of the New York and Erie, which then reported $10,023,958.84 of capital stock paid in, and $26,102,768.64 of bonds and floating debt. It followed, almost as a matter of course, in such an extensive enterprise, that it paid no dividends during a period of depression, and it has paid very few at any period, while the New York Central, which reported $24,154,860.69 of capital stock paid in, and $14,462,742.32 of bonds, with no floating debt, declared a dividend of 8 per cent., and has always been a dividend-payer. A number of other dividends, ranging from 5 to 8½ per cent. were declared, but in every instance by railways that had derived more of their capital from stockholders than from creditors, while the lines which, like the Erie, had adopted the other financial expedient, failed to pay dividends. Unfortunately in New York, as in some other of the states, some roads which had been built chiefly with money obtained from stockholders failed to promptly become dividend-payers, and there were certainly some roads of such a class that declared no dividends in 1855. There is no royal road to railway success, and we do not wish to be understood as asserting that it can be universally secured by reliance upon contributions from stockholders for capital, or that none of the roads which obtained much more capital from bondholders than from stockholders were successful or unable to pay dividends on capital stock. Either assertion would be absurd, in view of actual developments. But what we do mean to say, and what the statistics of 1855, and of all subsequent periods goes far to prove, is that the chances for making companies reliable dividend-payers are immensely increased by the acquisition of a large proportion of *bona fide* stock capital, in contradistinction to the creation of burdensome indebtedness. In the one case the excess of current receipts over expenditures naturally and properly goes to stockholders, and in the other a large share of it must go to creditors.

In New Jersey the leading dividend-payers of 1855 were as follows: Camden and Amboy, 12 per cent.; Central, 7; Morris and Essex, 7; and New Jersey Railroad and Transportation Company, 10. The Camden and Amboy failed to answer interrogatories and the amount of its debt was not stated, but all the other dividend-payers named reported a larger amount of stock capital than of bond capital, except the Central of New Jersey, which then had $2,000,000 of capital stock paid in, $3,000,000 bonds issued, and $135,795.35 of floating debt. The aggregate of New Jersey railway capital reported was $11,399,456 of capital stock paid in, $5,309,400 of bonds issued, and $1,302,610 of floating debt.

The aggregate statement of Pennsylvania was also of a conservative character, being $62,693,265 of capital stock paid in, $32,443,475 of bonds issued, and $4,486,591 of floating debt, and most of the old lines paid fair dividends. The list was as follows: Beaver Meadow, 10 per cent.; Columbia and Philadelphia (then a state railroad) earned 8¾ per cent. on its reported cost to the commonwealth; Cumberland Valley, 8; Harrisburg, Portsmouth, Mount Joy and Lancaster, 11; Little Schuylkill Navigation, Railroad and Coal Company, 8; Mine Hill and Schuylkill Haven, 12; Pennsylvania, 8; Philadelphia, Germantown and Norristown, 12; Philadelphia and Reading, 8 per cent. cash and 4 per cent. stock; Philadelphia, Wilmington and Baltimore, 4; West Chester, 4. The capital account of the two leading companies was as follows: Pennsylvania, stock, $12,480,000; bonds, $7,050,000; floating debt, $500,000. Philadelphia and Reading, stock, $10,830,360; bonds, $7,438,800; floating debt, $1,753,246.90 (but a note stated that an equal amount was due the company).

SOUTHERN AND WESTERN STATES.

The older Southern states made similar exhibits in regard to the relation between share and bond capital, the figures being as follows:—

	Amount of capital stock issued.	Amount of bonds issued.	Amount of floating debt.
Maryland	$13,515,902	$9,828,239	$......
Virginia	18,810,831	7,071,590	1,452,626
North Carolina	8,392,426	2,009,222	2,897,761
South Carolina	10,066,423	5,156,140	976,320
Georgia	19,562,386	1,634,467	20,000

Of the Maryland railways the capital reported is almost exclusively that of the Baltimore and Ohio, which declared a dividend of 6 per cent. on its main stem, and 9 per cent. on its Washington branch. Its capital stock represented $13,118,902; bonds, $9,754,939.73, and it had no floating debt.

Several of the Virginia roads declared dividends varying from 3 to 7 per cent., and a number of them reported that they were applying surplus earnings either to the extension of their lines or a reduction of debts. Of the North Carolina roads the Raleigh and Gaston declared a dividend of 6 per cent., and the Wilmington and Weldon 7 per cent. The South Carolina Railroad Company, which owned the leading railway of the state it traversed, declared a dividend of 8½ per cent. Nearly all the railways of the south-western states were such comparatively new enterprises that they furnish little instructive data bearing on dividends and the relation between bond and share capital.

It will be seen that the capital of the Georgia railways was represented by stock to an extraordinary extent, her showing in this respect being much better than that of any other state. This policy was accompanied with the unusual result of every completed railway in the state paying dividends of from 7 to 10 per cent. except two, one of which was the state road leading from Atlanta to Chattanooga, which earned a surplus of near 9 per cent. on its cost, that was paid into the state treasury, and another was the Augusta and Savannah, a road which had only been completed the previous year.

The great theatre of new construction that had recently been completed, or was progressing, was in western and north-western states, and it was in this region more than in any other that the practice of establishing a precarious relation between the various classes of capital was being adopted. On the surface the figures seemed to be sufficiently endowed with an excess of bonded indebtedness, especially in the states of Missouri, Ohio, and Illinois, in each of which the acknowledged debts considerably exceeded the reported amount of capital stock paid in, and there are reasons for the supposition that the *bona fide* payments of stockholders represented a much smaller amount of the reported receipts from such sources than had originally been common in the financiering of the early lines of the old states. "Amount of capital stock paid in" was beginning to mean something which differed materially, in some instances, from actual payments of cash by stockholders, such as subscriptions or bonds of towns, cities, or counties, which subsequently endeavored to evade their promised payments during years of protracted litigation, and considerable advances of stock to contractors as a partial remuneration of their labors, or to bankers or purchasers of bonds as an inducement to purchase or advance money on bonds.

Some of the new departures were apparently justified by the substantial aid expected from land grants. A partial excuse for all of them was furnished by the extraordinary rapidity with which the west was advancing in productiveness, wealth, and population, and the remarkable success of a few of the early western lines; and much of this western construction derived peculiar coloring from the essential difference between all the circumstances attending the origination and progress of a great line managed chiefly by prominent citizens of the communities in which it was located, with means furnished principally by them, as stockholders, and the concomitants of a line built mainly by comparative strangers, with means provided by distant investors.

The statements of all the lines of Missouri, Ohio, Indiana, Illinois, Michigan, Wisconsin, and Iowa for 1855 present the following aggregates: Miles completed, 5,122½; miles unfinished, 7,102½; amount of capital stock paid in, $95,850,146; amount of bonds issued, $110,270,317; amount of floating debt, $10,377,872; estimated cost, completed, $375,099,029; receipts, $19,320,744; net profits, $9,512,221.

Evidently the great west and north-west, or rather the men who represented their railway interests, were disposed to make heavy drafts on the future. In a large number of cases these drafts were duly or finally honored, but the instances are by no means rare in which the construction completed, progressing, or projected in 1855 became a fruitful source of financial difficulties.

Ohio led off with 2,233 miles completed, and 1,992 miles unfinished. Her dividend-payers consisted of the following companies: Cleveland, Columbus and Cincinnati, 15 per cent.; its capital was represented by $4,547,020 of stock, and only $113,018 of debt. Cleveland, Painesville and Ashtabula, 10 per cent., and 10 per cent. stock; its capital stock was $2,207,200, and bonded debt, $1,367,000. Cincinnati, Hamilton and Dayton, 5 per cent.; its capital stock was $2,153,900, and bonded and floating debt, $1,433,656.55. Columbus and Xenia, 10 per cent.; its capital stock was $1,484,550, and aggregate debt, $146,249.99. Little Miami and Xenia, 10 per cent.; its capital stock was $2,981,327.19, and aggregate amount of debt, $1,094,706.01. Mad River and Lake Erie, 7 per cent.; its capital stock was $2,697,090, and aggregate debt, $2,675,473.60. The relations between stock and debt reported by these dividend-payers present a striking contrast with the statement of the new lines, on which construction was then progressing, that led from Ohio to and through the adjacent states west of Ohio, viz.: The Eastern division of the Ohio and Mississippi, with $5,000,000 of capital stock paid in, and $10,000,000 of bonds issued, and the Toledo, Wabash and Western, with $2,500,000 capital stock paid in, and $7,000,000 of bonds issued.

The dividend-payers of Indiana were the Indiana Central, 6 per cent.. which had a stock capital of $612,350, and a debt of $1,251,000; the Terre Haute and Richmond, 10 per cent., which had $974,800 of capital stock, $675,400 of bonded debt, and no floating debt.

The reporting railways of Illinois were phenomenally successful as dividend-payers, notwithstanding an excess of bonded debt on some of the profitable lines, but this was due either to peculiarly fortunate localities or to revenue derived from land grants. The list included the Chicago, Burlington and Quincy, which reported an average dividend of 16 per cent.; Chicago and Milwaukee, 10 per cent.; Chicago and Rock Island, 10 per cent.; Illinois Central, 5 per cent.; Galena and Chicago, 22 per cent.

In Michigan the Michigan Central reported a dividend of 10 per cent. Its capital stock was $6,033,432, and bonded and floating debt, $6,506,823.

These statistics help to show the fallacy of the assertion frequently made that bond capital exclusively built American railways in nearly all cases; to indicate the importance of a relatively large share capital and the extent to which it usually affects the dividend-paying power of stocks; and the woful influence of a relatively large bonded and floating indebtedness in generating railway panics. While watered stock, representing no real capital, has sometimes gained earning value, of the bulk of it this assertion might be made: Water it was, water it is, and water it always will be.

RAILROAD STATISTICS OF 1860.

The increase of the mileage and cost of construction of steam railways from 1850 to 1860 in each state was reported in the preliminary report of the eighth census to be as follows:—

States.	Mileage.		Cost of construction, &c.	
	1850.	1860.	1850.	1860.
Maine	245.59	472.17	$6,999,894	$16,576,385
New Hampshire	465.32	656.59	14,774,133	23,268,659
Vermont	279.57	556.75	10,800,901	23,336,215
Massachusetts	1,035.74	1,272.96	47,886,905	58,882,328
Rhode Island	68.00	107.92	2,802,594	4,318,827
Connecticut	413.26	603.00	13,989,774	21.984,100
New York	1,403.10	2,701.84	65,456,123	131,320,542
New Jersey	205.93	559.90	9,348,495	28,997,033
Pennsylvania	822.34	2,542.49	44,683,054	143,471,710
Delaware	39.19	136.69	2,281,690	4,351,789
Maryland	253.40	380.30	11,580,808	21,387,157
Virginia	515.15	1,771.16	12,585,312	64,958,807
North Carolina	248.50	889.42	3,281,623	16,709,793
South Carolina	289.00	987.97	7,525,981	22,385,287
Georgia	643.72	1,404.22	13,272,540	29,057,742
Florida	21.00	401.50	210,000	8,628,000
Alabama	132.50	743.16	1,946,209	17,591,188
Mississippi	75.00	872.30	2,020,000	21,100,009
Louisiana	79.50	334.75	1,320,000	12,020,204
Texas	......	306.00	......	11,232,345
Arkansas	......	38.50	......	1,155,000
Tennessee	......	1,197.92	......	29,537,722
Kentucky	78 21	569.93	1,830,541	19,068,477
Ohio	575.27	2,299.45	10,684,400	111,896,351
Indiana	228.00	2,125.90	3,380,533	70,295,148
Michigan	342.00	799.30	8,945,749	31,012,399
Illinois	110 50	2,867.90	1,440,507	104,944,561
Wisconsin	20 00	922.61	612,382	33,555,606
Iowa	......	679.77	......	19,494,633
Missouri	......	817.45	......	42,342,813
California	......	70.05	......	3,600,000
Oregon	......	3.80	.....	80,000
Total	8,589.79	30,793.67	$296,660,148	$1,151,560,829

COMPETITION FOR THROUGH TRAFFIC.

ONE of the inevitable results of the extensive railway construction designed to facilitate intercourse between the Atlantic and Gulf states and the Western and interior Southern states was to create a broad ground-work for an excessively intricate and complicated system of competition for through traffic.

ADVANTAGEOUS POSITION OF WESTERN SHIPPERS.

There is scarcely a pivotal point in the interior of the Mississippi valley at which the shipper who has a considerable quantity of produce to forward, or a merchant who desires to receive a large consignment of goods from the seaboard, cannot have the choice of a large number of rival routes. Before the railway era there were but two great routes and their ramifications—one via the Mississippi and its tributaries, and the other via the lakes and their eastern outlets. Both these water channels have been materially improved by various descriptions of river and harbor improvements, the construction of the Welland Canal,—through which a vessel of several hundred tons burthen, loaded with wheat, was sent from Chicago to Liverpool, before the close of the sixth decade,—the enlargement of the Erie Canal, and the removal of some of the most serious obstructions on the Ohio and Mississippi and other rivers. But in addition to a choice between these water routes, the new rail lines, with the improvements since perfected, furnish opportunities for a selection between such a multiplicity of all-rail routes, and combinations of rail and water routes, that only trained experts could at short notice name all the possible avenues. After they had apparently exhausted the list it is by no means improbable that an advertisement soliciting propositions for the movement of a large amount of freight would elicit bids based on some routes that had been overlooked or forgotten. The maxim that all roads lead to Rome might be paraphrased by saying that nearly all American roads lead to the Mississippi valley, or out of it, and that there are as many ways of getting in as there are cities or sections that earnestly desired to make such an entrance, and as many ways of getting out as the interests and ingenuity of numerous rival western cities could devise.

From almost any point it may become a serious question whether a northern, southern, central, intermediate, all-rail, rail-and-lake, or rail-and-river route shall be chosen; whether a movement shall be made wholly on American soil, or partly through Canada; whether the first seaport reached shall be New Orleans, Mobile, Brunswick, Savannah, Charleston, Newport News, Norfolk, Baltimore, Philadelphia, New York, Boston, or Portland, and whether, in view of the extraordinary inducements sometimes presented, the most direct or the most indirect route is the cheapest. Such conflicts or competitions of routes and rival carriers are virtually a part of the system which planned railways with a view of extending lines from every important seaboard and gulf state into the interior, and then created alliances between such trunk lines and roads extending in all directions to as many points as possible.

Before 1860 the full force of these competitive influences was not realized, inasmuch as a number of lengthy southern roads leading into the Mississippi valley were then scarcely prepared for vigorous action, but they were constructed for the purpose of securing to the respective states and cities they were intended to serve a liberal share of interior traffic, and they have, at various periods, been engaged in through movements.

EFFORTS OF MERCHANTS TO FOLLOW EMIGRATING CUSTOMERS.

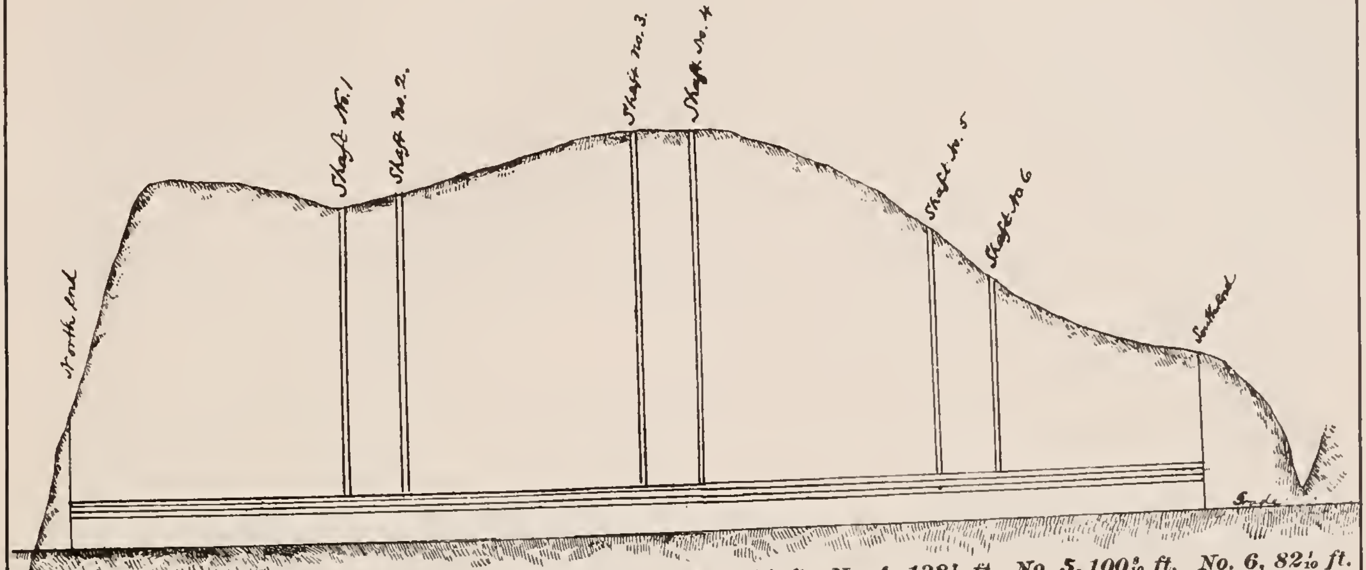
Nearly all American transportation systems that have assumed considerable magnitude, leading from the Atlantic to the interior states, have been materially influenced by considerations analogous to those which, during the colonial era, naturally led England, France, and Spain to establish and encourage trade with their respective American colonies. The Atlantic ocean and gulf of Mexico furnished for many years the principal avenues for bulky freight movements between each seaboard and gulf state, and they have continued to promote such ends to a great extent. But after emigration into the interior had created important markets for merchandise, and after they yielded considerable quantities of surplus products which their farmers desired to sell or send to distant customers, each ambitious seaboard city endeavored to follow up the march of the emigrants who had removed from the districts its merchants had been trading with for generations. New England and New York, represented chiefly by Boston and the city of New York, sought intercourse with the west via the lake route, and such ramifications of it as railways and canals furnished. Philadelphia endeavored to follow in the wake of the army of emigrants that had gone chiefly into the states lying directly west of Pennsylvania, first by the turnpikes to Pittsburgh; second by the state main line of public improvements; third by the Pennsylvania Railroad, and subsequently by the Philadelphia and Erie Railroad leading to the lake port at Erie. Baltimore aimed at the accomplishment of similar objects through the Baltimore and Ohio. Virginia, South Carolina, Georgia, and Alabama made analogous struggles, with varied success, to reach the states lying directly west or north-west of their frontiers, which had largely been peopled with their native citizens. While the star of empire was wending its way westward the general course of roads and improvements was naturally taking a similar direction, and the power of old associations and trade relations which had been in gradual process of formation during a long period helped to retain trade in something like its original channels. There were, of course, numerous obstructive or antagonistic influences, some of which exercised a controlling influence, and the extent to which commercial vitality and enterprise existed in various seaboard cities and was lacking in others had much to do with final results. But so far as regards the formation of routes and transportation systems the general purpose of enabling each old state to follow up its emigrants by convenient connecting links of internal communication had a very important influence in giving to a number of the existing through rail routes their present locations, and also in stimulating the competitive contests of rival through lines.

"RUINOUS COMPETITION."

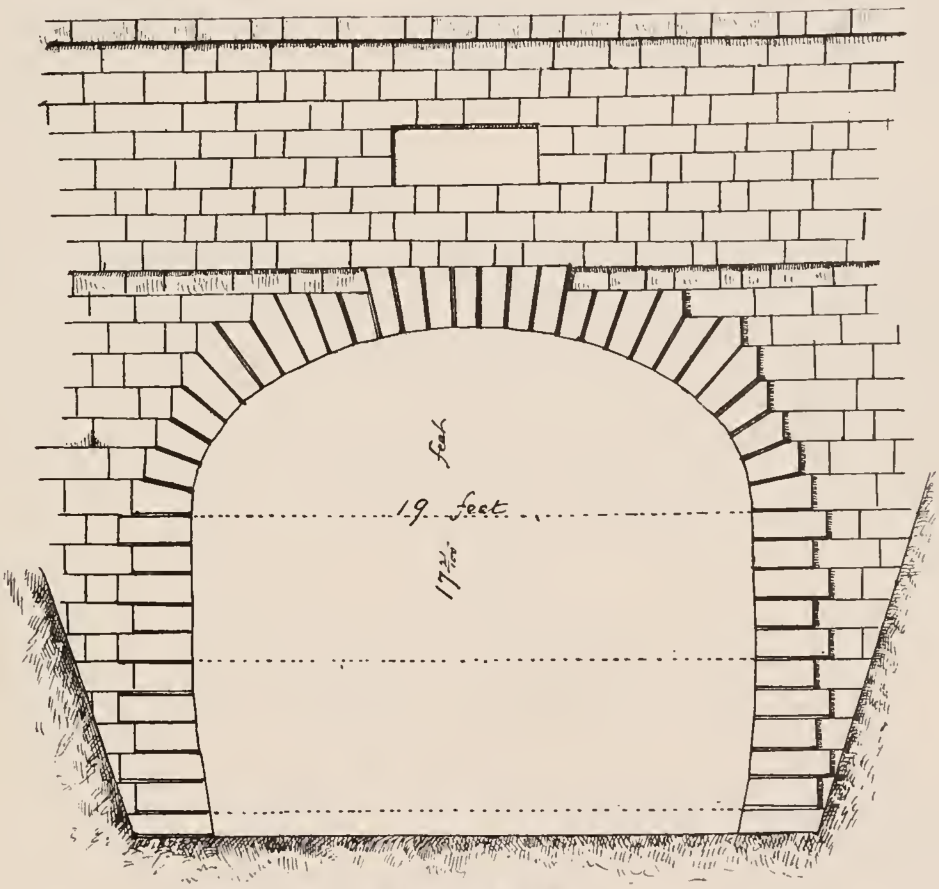
It was reserved for the northern trunk lines, however, including the New York Central, Erie, Pennsylvania, and Baltimore and Ohio to take leading positions in matters connected with through traffic, and an indication of the rapidity with which damaging rivalries sprang up is furnished by the fact that the annual report of the Pennsylvania Railroad Company for 1854, dated January 31st, 1855, and signed by J. Edgar Thomson, president, says:—

"With a view of agreeing upon general principles which should govern railroad companies in competing for the same trade, and preventing *ruinous competition*, a free interchange of opinions took place during the past year between the officers of the four leading east and west lines, and also with those of their western connections. The influence of these conferences, it is believed, will be felt in reducing expenses, correcting abuses, and adding to the net revenue of the several companies, while the public will be served with equal efficiency and greater safety. *Instead of an army of drummers and runners*, spread over the country, and paid by each company, an agent is now maintained, at the joint expense of the four lines, at all important points in the west, to distribute bills and give unbiased information to the traveler. The propriety of continuing even this modified system is doubted, as the same amount expended in advertising more extensively through the western press will, it is believed, prove more advantageous to the companies and satisfactory to the public."

There are few more important chapters in railway history



Depth of Each Shaft: No. 1, 116 4/10 ft. No. 2, 120 8/10 ft, No. 3, 139 4/10 ft. No. 4, 138 1/10 ft. No. 5, 100 8/10 ft. No. 6, 82 1/10 ft.



End View of Tunnel.

BLACK ROCK TUNNEL, ON PHILADELPHIA AND READING RAILROAD.

than those relating to the numerous conferences of a similar character which have since occurred, and the extent to which such agreements have repeatedly failed to accomplish their avowed objects.

There are reasons for supposing that while "ruinous competition" between trunk lines speedily reached the proportions referred to in the extract reprinted above, a large part of this competition related to classes of business differing from those which subsequently furnished the most damaging elements of corporate strife. At all events it certainly did not relate to through east-bound movements of breadstuffs and provisions to anything like the extent subsequently attained, and referred more particularly than in late years to

THROUGH PASSENGER TRAFFIC.

All the trunk lines were earnestly endeavoring to establish popular routes of travel over which western merchants would pass on their way to and from seaboard cities, all were endeavoring to assist the merchants of the cities they respectively represented to retain and increase their western trade, and they were also endeavoring to establish good records in connection with the cheap transportation of some particular articles, and especially flour, provisions, and live stock. But the most active strife was then presumably for passengers, and although this strife has been continued, in various phases, ever since, it has generally been of less real relative importance during recent years than it was previous to 1860. The Pennsylvania made particularly active exertions to attract travel, and its success was increased by its acquisition of convenient connections leading from Harrisburg to Baltimore, via the Northern Central, and from Harrisburg to New York via the Allentown route, and Central of New Jersey—so that it presented inducements to travelers whose destination or point of departure was New York or Baltimore, as well as those who desired to visit or depart from Philadelphia.

The Baltimore and Ohio laid much stress then, as at later periods, upon its advantages as a route that gave passengers an opportunity to visit Washington city. A bitter contest sprung up between the Erie and the New York Central for the passenger traffic between New York city and Lake Erie, which led to exceptionally hostile demonstrations in a few years after the date of the conference referred to by Mr. Thomson.

This strife, which was exceptionally acrimonious, and led to a fearful cutting of rates, was followed by another treaty or agreement in 1858, signed by the presidents of each of the four American trunk lines, with the understanding that S. M. L. Barlow, then president of the Ohio and Mississippi, should act as umpire in case of a renewal of strife; and a number of rules were clearly laid down relating not only to passenger traffic, but to the rates to be maintained on various classes of freight traffic, and especially the east-bound movement of live stock, and the west-bound movement of merchandise forwarded from Boston.

THE CONDUCTOR OF THE SIXTH DECADE.

For the reasons given above, the early wars and competitive struggles of rival trunk lines were more likely to become intensely active in connection with passenger traffic than in connection with the western movement of merchandise, or eastern movement of live stock and grain, and this or other causes may have increased the necessity for selecting as conductors specially popular or influential persons. At all events, the conductor, as the representative of the railroad company who was brought into closer direct contact with the public than any other railway official, was formerly a more important personage than he is apt to be at present on old lines.

William Chambers, one of the most intelligent and unprejudiced of modern English tourists, who visited this country and subsequently printed his impressions of it, in a work recording his views of American railways, founded on a tour in 1853, gives the following description of the conductor of that era:—

"An American conductor is a nondescript being, half clerk, half guard, with a dash of the gentleman. He is generally well dressed; sometimes wears a beard; and when off duty he passes for a respectable personage at any of the hotels, and may be seen lounging about in the best company with a fashionable wife. No one would be surprised to find that he is a colonel in the militia, for 'good whips' in the old coaching time are known to have boasted that distinction. At all events, the conductor would need to be a person of some integrity, for the check upon his transactions is infinitesimally small. One thing is remarkable about him—you do not get a sight of him till the train is in motion, and when it stops he disappears. I can account for this mysterious feature in his character, only by supposing, that as soon as he touches *terra firma*, he removes from the front of his hat the word blazoned in metal, which indicates his office, and so all at once becomes an ordinary human being. The suddenness of his appearance, when the train gets under way, is very marvelous. Hardly have the wheels made a revolution, when the door at one end of the car is opened, and the conductor, like a wandering spirit, begins his rounds. Walking down the middle, with a view of seats on each side, and each seat holding two persons, he holds out his hand right and left as he proceeds, allowing no one to escape his vigilance. All he says is 'tickets,' and he utters the word in a dry, callous tone, as if it would cost something to be cheerful. If you have already bought a ticket, you render it up to this abrupt demand, and a check ticket is given in exchange. Should you have followed the ordinary practice, and have no ticket to produce, the conductor selects the ticket you require from a small tin box he carries under his arm, and you pay him the cost of it, increased in price to the extent of five cents, as a penalty for having had to buy it in the cars—such fine being imposed in accordance with a printed notification on the walls of the station houses."

Much has been done, since this description was written, to increase the checks upon the operations of conductors; on some lines the necessity of such changes was clearly indicated; and modern English tourists would be less likely to find in the older states a conductor acting as a colonel of a militia or volunteer regiment, and lounging about an expensive hotel with a fashionable wife.

THE BASIS OF WESTERN TRAFFIC.

For some years before the trunk lines had been extended to points west of the Alleghenies, and especially during the turnpike and canal eras, it had been feasible to send west from the north Atlantic seaboard numerous descriptions of merchandise to districts which sought an outlet for their surplus agricultural products over other routes, including those furnished by the Mississippi and the Welland Canal, and an analogous condition of affairs helped to restrict, in a similar manner, the range of trunk-line labors during their early operations. An east-bound traffic in western manufactured articles, such as agricultural implements, glassware, &c., sprang up at a comparatively early period. Generally speaking, the original idea that railways should not seriously attempt to carry exceptionally cheap and bulky articles, which could not afford to pay remunerative rates, continued to prevail to a much greater extent than in later years.

The limited extent of the freight business of the trunk lines, previous to 1860, can scarcely be realized by those who do not unite familiarity with their modern statistics to a knowledge of their transactions before that time.

The following particulars relating to the tonnage of the Pennsylvania and New York Central in 1859 help to explain the limited amount of freight moved over their lines at that time:—

On the Pennsylvania Railroad 129,767 tons were carried from Pittsburgh to Philadelphia and Baltimore; 223,397 tons from way stations to Philadelphia, making a total east-bound movement, way and through, of 353,164 tons. The largest amount of tonnage furnished by any single article was derived from coal forwarded from points east of Pittsburgh to Philadelphia. It consisted of 218,853,843 pounds, or 109,427 tons. The only other articles furnishing more than 10,000 tons of traffic were the following: Flour, through from Pittsburgh to Philadelphia and Baltimore, 64,642,265 pounds, and from way stations to Philadelphia, 39,396,464 pounds; grain, all kinds, not specified, 14,550,235 pounds from Pittsburgh to Philadelphia and Baltimore, and 47,441,734 pounds from way stations to Philadelphia; live stock, through from Pittsburgh to Philadelphia or Baltimore, 65,103,756 pounds, and from way stations to Philadelphia, 33,731,504 pounds; salt meats, through from Pittsburgh, 31,199,251 pounds, and from way stations to Philadelphia, 195,240 pounds; lumber and timber, 57,891,445 tons, forwarded from way stations to Philadelphia.

The articles carried westward on the Pennsylvania Railroad, in 1859, consisted of 103,839 tons forwarded through from Philadelphia and Baltimore, and 86,866 carried to way stations from Philadelphia. The only articles furnishing more than 10,000 tons of traffic, consisted of 57,297,296 pounds of dry goods forwarded through to Pittsburgh and 8,440,136 pounds forwarded to way stations from Philadelphia; and 19,286,909 pounds of groceries (except coffee) sent through to Pittsburgh, and 29,806,037 pounds sent to way stations from Philadelphia.

The above statistics relating to the Pennsylvania Railroad, omit local freight taken up at various points along the line to be sent to Pittsburgh and places further west and they make no mention of freight forwarded east from Pittsburgh to way stations,—so that they do not fully report all freight movements on the Pennsylvania Railroad. But after sufficient allowance is made for these exceptions the relatively limited extent of the freight traffic before 1860 is illustrated.

The through tonnage eastward of the New York Central, in 1859, was 244,441 tons; eastward way tonnage 336,686; total way and through 570,927, classified as follows: Manufactures, 38,527; merchandise, 13,692; all other classes, 518,708. The "other classes" consisted chiefly of animal and vegetable food, and the latter slightly exceeded the former in furnishing way traffic, while the through tonnage eastward consisted of 112,210 tons of the products of animals, against 101,288 tons of vegetable food. The west-bound tonnage of the New York Central, in 1859, consisted of 113,838 tons through and 149,554 tons way, a total of 263,392 tons, classified as follows: Manufactures, 18,509; merchandise, 165,090; all other classes, 79,793 tons.

The statistics of the other trunk lines are all of an analogous character so far as they bear on the matter of the relatively limited amount of freight of all classes then carried by those lines, and, indeed, on all the other American railways of that period, except the coal roads. A very considerable through movement of western agricultural products was nevertheless then progressing, but a larger proportion of it was forwarded over water routes to the seaboard than in later years, and the change which subsequently occurred in this particular direction forms one of the most remarkable and important features of American railroad development. It was hastened and intensified by the marvelous increase in the population, productiveness, and commercial transactions, as importers and exporters, of the western and north-western states.

INCREASE OF NATIONAL WEALTH.

IN addition to the important effects of the extensive railroad construction during the sixth decade, which have already been discussed, viz., railway panics and railway competition, there was another of much greater consequence—an immense increase in national wealth and productiveness. On this subject statisticians of the seventh decade who carefully studied the returns of the census of 1860, and other contemporaneous writers, speak in the most positive terms. Various forms of western agriculture were practically revolutionized. It became possible to cultivate with profit a large amount of land that could not previously be advantageously utilized.

From 1850 to 1860 the national wealth, according to the census estimates, was more than doubled, the rapidity of increase being never equaled in this or any other country of corresponding wealth or magnitude. The aggregate estimates of the marshals, who were directed to ascertain as correctly as possible the true value of real estate and personal property, were as follows: 1850, $7,135,780,228; 1860, $16,159,616,068; increase, $8,925,481,011, or 126.45 per cent. The most remarkable gains occurred on the Pacific coast, and the Western, North-western, and South-western states. Various causes helped to create this wonderful increase of wealth, and in some localities it was only due in a slight degree, or not at all, to railway construction. But in many other sections the new railways were leading causes of the great advance.

INCREASE OF AGRICULTURAL WEALTH CAUSED BY RAILROADS.

The census report on agriculture in 1860, in discussing this subject, says:—

"We now proceed to show the positive advantages which all departments of agriculture have derived from the construction of railroads. *So great are their benefits that if the entire cost of railroads between the Atlantic and Western states had been levied on the farms of the central west, their proprietors could have paid it and been immensely the gainers.* This proposition will become evident if we look at the modes by which railroads have been beneficial, especially in the grain-growing states. These modes are, first, in doing what could not have been effected without them; second, in securing to the producer very nearly the prices of the Atlantic markets, which is greatly in advance of what could have been had on his farm; and third, by thus enabling the producer to dispose of his products at the best prices at all times, and to increase rapidly both the settlement and the annual production of the interior states. . . .

By giving the farmer the benefit of the best markets and the highest prices, railroads have increased the agricultural productions of the interior states beyond anything heretofore known in the world. We have already shown that this increased production, or rather its surplus, could not have been carried to market without the aid of railroads, more than two-thirds of the whole being carried off by that means. Let us now reverse this operation, and we find, on the other hand, that railroads have stimulated and increased production.

The North-western states are those in which the influence of railroads on agriculture is most obvious. In the five states of Ohio, Indiana, Illinois, Michigan, and Wisconsin there were comparatively few miles of railroad prior to 1850, but from 1850 to 1860 the construction of roads was most rapid. In 1850 there were only 1,275 miles of railroad in those states, but in 1860 there were 9,616 miles. Let us now examine the products of those states in 1850 and 1860, and see how the progress of railroads has sustained and stimulated agricultural production. The following table shows the increase of the principal vegetable and animal production in the five states of Ohio, Indiana, Illinois, Michigan, and Wisconsin in the ten years from 1850 to 1860:—

	In 1850 (bushels).	In 1860 (bushels).	Inc. p.c.
Wheat	39,348,495	79,798,163	100
Corn	177,320,441	280,268,862	58
Oats	32,660,251	51,043,334	50
Potatoes	13,417,896	27,181,692	100
Cattle (number)	3,438,000	5,371,000	59

This increase is decidedly beyond that of population, showing that the products of agriculture are in those states profitable. The aggregate of grain products in those states, including wheat, rye, corn, oats, barley, and buckwheat, was, in 1850, 255,240,444 bushels, and in 1860, 422,369,719 bushels.

What part railroads have had in carrying this product to market we shall see by ascertaining the surplus, and the manner in which it was transported. A report to the legislature of Ohio, estimates (in the actual carriage of railroads and canals) that *three-fifths* of the value of agricultural products of Ohio are exported, excepting, of course, pasturage, fruits, garden products, &c. In 1859–60 twelve millions of bushels of wheat were exported from that state, and an equal proportion of corn, reduced into other forms, such as fat cattle, hogs, pork, lard, whisky, cheese, &c. Three-fifths of the aggregate grain production of these states (1860) will give two hundred and fifty millions of bushels of grain. This is vastly greater than the whole tonnage of the canals and railroads, and would, therefore, seem incorrect. This, however, is not so. The heaviest article (corn) is reduced to a fourth, perhaps less weight by being changed into whisky, pork, and cattle. The same is true of oats, and thus ten millions of tons represented by the canals and railroads may cover all the surplus which finds the extreme eastern markets. A large quantity of the surplus products of these states is consumed in way markets. We see now, that since railroads carry two-thirds of this immense export, they represent nearly or quite the same proportion of the capacity of those states to raise any surplus, and, therefore, two-thirds of the profit made upon it. If we now consider the question of the profits of agriculture the case becomes still stronger. The actual cash value of the products carried to market from these five states (that is, the surplus), is two hundred millions of dollars, and it is safe to say that one-half this sum is due to the influence of railroads. There are some interesting facts on this subject, to some of which we will briefly allude. Take, for example, the price of both products and lands in the interior states, and compare them at different periods. Forty years ago (1824–25) the surplus products of Ohio had already accumulated beyond the means of transportation. In consequence of this fact, wheat was sold in the interior counties for 37 cents per bushel, and corn at 10 cents. After the New York canal (Erie) was finished in 1825, and the Ohio canals several years later, these prices were raised more than fifty per cent.; but when two or three of the main railroad lines were finished in 1852–53, the rise in prices and the amount carried forward to the eastern markets were even more increased. To show, in some measure, the effect of the improved means of transportation on the value of produce in the interior, we make the following table of prices at Cincinnati at several periods:—

	In 1826.	In 1835.	In 1853.	In 1860.
Flour, per barrel	$3 00	$6 00	$5 50	$5 60
Corn, per bushel	0 12	0 32	0 37	0 48
Hogs, per cwt.	2 00	3 12	4 00	6 20
Lard, per pound	0 05	0 08	0 08½	0 11

We find that in 1860 the price of flour was nearly double that of 1826; the price of corn nearly four times as much; the price of hogs three times as much, and the price of lard double. From 1835 to 1860 (when the railroads were completed), under the influence of railroad competition with canals, the price of corn advanced 50 per cent., and that of hogs 100 per cent. Perhaps no articles can be selected which furnish a more complete test of the value and profits of farming in the states of the north-west than that of these staples, corn and hogs.

But there is another respect in which the influence of railroads is almost as favorable to agriculture as that of cheapening the transportation of produce. It is that of cheapening the transportation, and, therefore, reducing the prices of foreign articles and eastern manufactures consumed by the farmers of the interior. . . . Again, the influence of railroads on the value of farming lands is too great and striking not to have been noticed by all intelligent persons. We have, however, some remarkable instances of the specific effect of certain railroads. We have, for example, the immediate effect produced on the lands of Illinois by the Illinois Central Railroad. That company received from the Government a large body of land at the time when the Government could not sell it at a dollar and a quarter ($1.25) per acre. Since then the company has constructed its road and sold a large part of those lands at an average of $11 per acre, and the greater part of the lands is fully worth that. Notwithstanding the rapid growth of population, the large part of this advance is due to railroads. The following table shows the advance (by the census tables) of the cash value of farms in the five states mentioned in the ten years from 1850 to 1860:—

	1850.	1860.
Ohio	$358,758,602	$666,564,171
Illinois	96,133,290	432,531,072
Indiana	136,385,173	344,902,776
Michigan	51,872,446	163,279,087
Wisconsin	28,528,563	131,117,082
Aggregate	$671,678,075	$1,738,394,188
Increase in ten years		$1,066,716,113

It is not too much to say that one-half this increase has been caused by railroads, for we experience already the impossibility of conveying off the surplus products of the interior with our railroads. Putting the increase of value due to railroads at a little more than one-third, we have four hundred millions of dollars added to the cash value of farms in these five states by the construction of railroads. . . . If the effect on the central western states has been so great, it is still greater in the new states which lie beyond the Mississippi. They are still further from market, and will be enriched in a greater ratio by the facilities of transportation. Indeed, railroads are the only means by which the distant parts of this country could have been commercially united, and thus the railroad has become a mighty means of WEALTH, UNITY, AND STABILITY."

THE RAILROAD NOT ALWAYS A PHILOSOPHER'S STONE.

Many other statements published soon after 1860, which were based on the census reports of that year, or other statistics, referred to facts scarcely less significant than those reported above, illustrating the beneficial effect of railroads in increasing the wealth of cities, or the value of coal lands, lumber districts, or cotton-producing regions, as well as western and north-western farms. It seemed as if the railroad, above all other things previously tried, had the power of creating wealth or turning everything it touched into gold. Subsequent developments have shown, however, that some of the theories advocated were delusive, and that some of the expectations encouraged were not realized. There is a limit to the power of railroads in creating advantageous markets for surplus agricultural products or anything else, and there is a limit to the list of profitable advantages any community or interest can derive from an increase of the number of the railroads by which it is served, especially if they are parallel or competing lines and paid for with home capital.

While Ohio was greatly benefited in 1860 by the lines built to and through her territory, it is not improbable that some of her agricultural interests were temporarily injured in several respects, by the extension of these lines or their connections to more distant western states, and analogous efforts may have been produced in various other sections.

It is also a fallacy to suppose that because one railway adds greatly to the wealth of a particular city or district, equal gains will be derived from each addition to the number of its railways of a given class or capacity. However useful one railway may be, its unnecessary duplication is more apt to mean a waste of capital than anything else, and if the burden of this waste or loss is thrown upon the community served, it may be impoverished, rather than enriched, by the useless new construction. It is easy to understand that a farmer who gradually extends the area of his arable land, by increasing the number of horses that can be worked advantageously upon it from one to four, may be materially benefited by each of these additions; but if four horses can do for him all the useful work that he is prepared to apply to his farm, he will be more likely to grow poor than to increase his wealth, if he doubles his equine force, for he will then be burdened with the cost of maintaining four useless animals that add nothing to his revenues, while they swell his expenses and annoyances. Something analogous occurs in connection with the unnecessary duplication of railway facilities.

CHANGES IN PERMANENT WAY.

ADVANCE FROM EDGE-RAILS TO T-RAILS ON THE COLUMBIA AND PHILADELPHIA RAILROAD.

ONE of the events of the sixth decade, which was presumably typical of similar occurrences elsewhere, was the substitution of T-rails for edge-rails on the portions of the Columbia and Philadelphia Railroad which had been originally laid with the latter. As on this road it had been considered necessary to substitute T-rails for the strap-rails used on portions of the line some years before, and after the latter had been in use for only a comparatively short period, a notable proof of the excellence of the iron used in the edge-rails was furnished by the fact that many of them were used continuously on this road for more than a score of years. There was evidently much to justify the very decided preference of the civil engineers of the early lines for edge-rails over strap-rails, but the difficulty of keeping the edge-rails fastened in their chairs, and other troubles, arising from the use of stone blocks as a foundation, and absence of ties, except a very limited number, increased with the progress of years and the growth of traffic. In proportion to the amount of labor employed for all maintenance-of-way purposes, the single task of keeping tight the wedges on the side of the rails at the places where they were supported in chairs, was specially onerous and expensive. In spite of the greatest care, too, more or less uncertainty existed in regard to the real condition of the track, and it was specially liable to become unsafe in the spring of the year, when the frost was coming out of the ground, and rails would not unfrequently be raised out of the chairs by the pressure underneath. One of the effects of the opposing influences to which the rails were subjected was that they often became seriously bent, and it was necessary that they should be taken out of the chairs and straightened by appliances and devices of a rude description. In addition to the difficulties arising from this cause, the general system of drainage was defective, as on other early American lines. The provisions for keeping the road-bed in order, except in matters of absolute necessity, were of a scanty and primitive nature, and track-spreading was much more common than at present.

As a result of this state of things, great care was requisite in running trains over the road, derailments of trains were common, and the establishment of reliable fast schedules for passenger trains was not even attempted.

At periods of the sixth decade prior to the sale of the road to the Pennsylvania Railroad Company in 1857, the state relaid with 64-pound T-rail the portions of the line on which T-rails had not previously been placed. Many benefits were expected from this change, especially as a large amount of ballasting was done, either with broken stone or with cinder, which, although far inferior to best modern methods, represented an important advance; and as a new road was substantially created on the basis of the old one, it being raised at many places by the ballast and ties about or nearly two feet, although at other places, such as the approaches to bridges, the old grade was retained. A considerable number of the old stone blocks, used as the foundation of the chairs by which the edge-rails were supported, were removed, and used for various purposes, but many others were left remaining or practically buried in their original positions. Wooden ties were used at the rate of twelve ties to a 25-foot rail, but they were generally much inferior in desirable qualities to the ties used on the same road at the present day. The width between the tracks was also increased from four and a half to six feet, which was subsequently increased, some years later, to seven feet.

In making the change from the edge-rail to the T-rail, the part of the road on which work was progressing was temporarily abandoned for operating purposes, and all movements, in both directions, transferred to the adjacent track, on which the process of "running the gauntlet," or having trains run in both directions, was conducted, so that ample opportunities were afforded for radical changes.

DISAPPOINTING RESULTS ON ACCOUNT OF DEFECTIVE FROGS AND INFERIOR T-RAILS.

Notwithstanding the advantages anticipated from practical reconstruction, which included the substitution of a heavier rail, of a better shape, and the liberal use of ties and ballast, the improvements did not fully meet anticipations. The great immediate gain was in the avoidance of rail-straightening requirements, and of the labor and anxiety arising from the necessity of constantly tightening the wedges used in the chairs. But a new source of danger was developed in the unsatisfactory working of the new chairs used in connection with the T-rails. For a number of years after their adoption had ceased to render chairs useful for their leading original purpose of acting as a sustaining base of the rail, chairs of various materials, shapes, and patterns were deemed necessary as joints or connecting links of rails, and a considerable period elapsed before a reasonably satisfactory substitute was devised. Inventive efforts then generally took the shape of changing the material or form of chairs, in its efforts to provide rail-joints, instead of radical changes which dispensed entirely with the use of chairs for this purpose. The first chairs used on the Columbia and Philadelphia Railroad, in connection with the T-rail, which succeeded the edge-rail, were made of cast iron, and for this or other reasons were decidedly unsatisfactory. They were succeeded by a wrought-iron chair, made at Phœnixville, which was considered at the time a great improvement.

There was considerable difficulty with the new T-rails on this as on many other roads, arising from imperfections of material, or workmanship, or other causes. In this particular instance it had been considered very desirable, on account of the demonstrated excellence of the iron used in the old edge rail, to require that it should be rerolled and used as a portion of the material of the new T-rails provided. As the edge rails were removed they were sent to the rolling mill to be used in this manner. It was subsequently supposed that the union of this material with other iron was not as thoroughly effected as was desirable. For this or other reasons it became common, after some of the new T-rails had been in service for a comparatively short period, for considerable portions of their upper surface to scale off as if it had consisted of thin pieces of hoop iron. It was necessary to renew a number of such rails; the wearing quality of all of them fell below expectations; and it was a common occurrence for rails to break at times when sudden changes in temperature occurred, or when the frost was coming out of the ground.

SWITCHES AND FROGS.

In connection with the substitution of T-rails for edge rails the switches and frogs used on the road were changed. At various periods different patterns and materials had been employed, the frogs being at one time made of cast iron and tongue switches being used. At another period a pivot rail had been used as a substitute for a frog. It was about nine feet in length, and about four and a half feet from either end of the rail a bolt went down from its base into a plate set on a tie and keyed fast there. A fulcrum was furnished, and a sideling movement at either end of the rail insured a corresponding movement at the other end. This was found to be an inconvenient or troublesome device, and was succeeded by what was known as the Lewis frog.. Tongue switches were also succeeded by stub switches, and after the change from edge-rails to T-rails various modifications of the frogs and switches previously in use were introduced, to which considerable importance was attached.

CHANGES WHICH SUCCEEDED THE TRANSFER OF CONTROL TO THE PENNSYLVANIA RAILROAD.

After the Pennsylvania Railroad purchased and acquired possession of the Columbia and Philadelphia Railroad, during the closing years of the sixth decade, some of the first changes made consisted of the establishment of ticket offices and passenger stations at various points; the erection of platforms at passenger stations; the purchase of buildings previously used by forwarding and commission merchants, which served as freight depots; the improvement of facilities for storing and furnishing wood, or other fuel, and water, to the locomotives; the construction of a few crossings, by which trains could move from one track to another, so as to enable freight trains to give the right of way to passenger trains, which crossings were subsequently materially increased in number, and supplemented by extensive sidings and stretches of third and fourth tracks; the adoption of a regular system of frogs and switches, involving some differences in the preceding methods, especially in frogs; and a notable improvement in all details relating to maintenance of way, especially in the liberality of the supplies of labor, tools, and materials, and in the degree of accountability of those entrusted with all forms of authority in superintending labors and outlays, or acting as custodians of supplies.

It was also soon found necessary to devote much attention to the strengthening of bridges, including overhead crossings of common roads, as well as the more important structures, and to increase the effectiveness of culverts.

ESTABLISHMENT OF PASSENGER STATIONS.

A notable illustration of one of the differences between old and new railway methods is furnished by the fact that the road had been in operation for about a quarter of a century previous to its acquisition by the Pennsylvania Railroad, with not a passenger station along its line, public houses or inns furnishing such accommodations as were considered necessary, and no tickets being sold. This condition of things was largely due to the fact that the state, as the owner of the road, only furnished to transporters opportunities for using it and locomotive power, and not being the owner of passenger or freight cars, or the direct transporters of either freight or passengers, it had no special interest in supplying passenger stations or freight depots. But to a considerable extent this lack of convenient accommodations for passenger and freight movements was typical of a corresponding deficiency on many of the railway lines of the country which were operated in the fullest sense by the companies owning them. Deficiency of station, depot, and terminal facilities was a notable feature of nearly all American railways up to the end of the sixth decade, and similar deficiencies continued to exist on nearly all lines up to a considerably later period, as it exists at many points even at the present day. The large expenditures necessary to partially supply these deficiencies have been one of the most prominent causes of the increased cost and capitalization of numerous lines.

DEFECTS OF IRON T-RAILS.

Another influence affecting many roads, which was illustrated by developments on the Columbia and Philadelphia, was the inferior nature of the material or workmanship of many of the iron T-rails used on the line. This was a chronic trouble, and the tendencies were rather towards deterioration than improvement. It would have seemed a natural supposition that if edge-rails had stood the wear and tear of traffic for a score of years or more, iron T-rails of greater weight and better shape should at least possess approximately equal powers of endurance; but partly on account of the increased amount of transportation and increase of the weight of cars and locomotives, and more particularly on account of inferior material and method of manufacture, the life of the new T-rails laid down on the Columbia and Philadelphia Railway was at exposed points only extended over two or three years, and on nearly all the road renewals became necessary after they had been in service six or seven years. Similar and even much more notable defects of iron rails were developed on many other roads, and at later periods. In fact, defective iron T-rails furnished during a protracted period one of the most damaging and deplorable features of the entire American railway system, whether regard is paid to financial results, assurances of safety, or provisions for efficiency.

IMPERFECTIONS OF AMERICAN LINES.

It is part of the history of the sixth decade that, either on account of the rapidity with which new lines had been constructed, or the imperfect nature of many of the American roads and the appliances used upon them, or the relatively high rate of labor in this country, or other causes, the English roads were reported to be capable of doing about twice as much work for a given amount of money as the railways of the United States. During the last quarter of a century the position of a number of representative lines of the two countries has been reversed, and an elaborate discussion of this subject in 1885 indicated that American roads could carry freight for about half the cost then common on English lines. Such a great change was not speedily effected, and it required very extraordinary advances of the systems prevailing previous to 1860.

The relative cost of maintenance and running expenses, under the old order of things, was reported to be as follows on the typical English and New York lines named below in 1855:—

Name of roads.	Number of miles of single track.	Average number of trains both ways, daily.	Average cost of repairs per mile of single track.	Average cost of repairs per mile run, in cents.
English lines:—				
London and North-western	1,290	21.17	$432 88	6.24
Eastern Counties	1,168	13.3	356 22	8.40
London and Brighton	354	19.95	544 39	8.18
Great Northern	628	25.37	709 16	8.88
New York lines:—				
New York Central	862	12.42	841 03	24 96
New York and Erie	741	12.55	687 57	18.62
Harlem	181	9.63	785 29	28.18
Average New York roads	3,542	10.30	655 97	23.20

It was estimated that in 1857 the average expenditure for maintenance of way per mile run on English roads was 10.56 cents; in France, 7.8 cents, and in the United States, 25 cents.

THE NECESSITY OF KEEPING DOWN THE COST OF ORIGINAL CONSTRUCTION

to a very low standard was one of the main causes of imperfections in the permanent way which materially increased operating expenses. Railways are often in danger of being driven too closely either to the Charybdis of spending so much on their lines that it becomes very difficult to earn interest on their outlays, or the Scylla of spending so little that there is a very slight margin for profit left above inevitable current expenses. To work cheaply considerable outlays must in any event be made, and on many lines immense sums have been advantageously expended which had no other immediate object than the reduction of the necessary cost of a given amount of current business. In one of the early reports made by J. Edgar Thomson, as president of the Pennsylvania Railroad, he earnestly advocated endeavors to make the operations of that company profitable rather by doing a very large freight business at low rates and small profits, than by carrying a small amount of freight at high rates and large profits. This course has since been pursued on many important lines, but it obviously could only have been rendered successful by very expensive improvements of the original lines, and large outlays on new roads, as it would have been ruinous to attempt on the old style roads such cheap transportation as now forms part of current railway labors. During the sixth decade much remained to be done in this direction. The drainage of many roads had been sadly neglected, many bridges were inferior or defective, and attempts to construct them over some of the great rivers which are now crossed at many points had scarcely been commenced.

IMPROVEMENTS OF RAIL-JOINTS

were attracting considerable attention, but something like the original chairs were still used very extensively. A transition was progressing in the United States. Of the nature and utility of a corresponding movement on English lines, an English engineer, in an address delivered in 1883, said: "Cast-iron chairs were used to hold the rail in position; and as, owing to the nature of the material employed, those chairs were frequently injured, the first efforts for the improvement of the rail were directed to dispensing with the chairs. But the forms of rail introduced for this purpose did not effect their object, for practical reasons which it is not necessary here to go into. Mr. Locke introduced the double-headed rail, the ends of which were at first made to rest in the chair; but the effect of this plan was found to be that the rails were speedily worn at the ends, and they had to be replaced. The fish-plate was introduced to remedy this defect. The fish-plate was a great improvement in the permanent way of railways. It consists, as you are aware, of two plates of iron placed on each side in the hollow of the rail immediately under the head, the plates being held together by bolts passing through them and through the rail, the bolts being screwed up tight to the rail at the joint by nuts. The effect is to make the rail as nearly continuous as is practically possible."

RAILS, SWITCHES, FROGS, AND IRON BRIDGES.

The American rail mills had commenced rolling rails thirty feet in length, which were no longer considered unwieldy, and there was a decided tendency to increase the weight per yard, of new rails laid down on important lines. Switches and frogs were also receiving much attention, and inventors were rapidly swelling the list of available new railway appliances.

Other changes of material consequence were the rapid substitution of iron for wood as a material for railway bridges, the improvement of designs for bridges, and modifications of the methods of using cast and wrought iron in the construction of bridges. The Pennsylvania Railroad was specially active in promoting the construction of iron bridges on its western division, and the Reading, Erie, and Baltimore and Ohio also made important advances.

BRIDGE-BUILDING PROGRESS.

IN connection with the iron bridge building of the sixth decade in the United States, three classes were then being tested, viz.: First, combinations of cast and wrought iron, deemed available for a span of from 50 to 200 feet; second, suspension, considered available for a span of from 200 to 2,000 feet; and, third, boiler-plate girder, considered available for a span of from 25 to 100 feet. Tests of a Bollman trussed bridge, on the Baltimore and Ohio, of a clear span of 124 feet, which contained 65,137 pounds of cast iron and 33,527 pounds of wrought iron, had been considered very satisfactory. A famous suspension bridge had been erected at Niagara for the use of the New York Central and Canada and Great Western, which is described below. A 55-foot boiler-plate bridge had been built for the Baltimore and Susquehanna, by James Millholland, in 1847. A number of Whipple iron bridges had been erected, on one of which, on the line of the New York and Erie Railroad, cast iron was used as a top chord, and wrought iron employed to resist the tensile forces. Wooden bridges continued to be in almost universal use, and a very large number were erected during the decade. Improvements in the methods of their construction were devised and patented, some of which furnished the plans for iron bridges. Few, if any, of the new bridges were then rising more rapidly in importance than those of Fink and Howe, and the use of the latter was especially extensive.

Wooden trestling was frequently resorted to during the sixth decade, and the railways of that era furnished numerous examples of trestling of various arrangements, and of heights of from twenty to two hundred feet. It was divided into two leading classes, one of which was intended for temporary use in enabling a road to pass over low ground with the expectation that it would be eventually filled up and converted into embankments; while the second was intended to furnish a permanent foundation for a bridge erected over a deep dry gorge or river.

The most notable example of the second of these classes was the Genessee high bridge, over the Genessee river, near Portageville, on the Buffalo and New York Railroad, built by H. C. Seymour. It was 800 feet long, 230 feet above the river. It had eight stone piers, 30 feet high, upon which were placed trestles 190 feet high, 75 feet wide at base, and 25 at top. Above the trestle work was a bridge 14 feet high. The cost of this structure was $140,000.

BRIDGING NIAGARA AND THE MISSISSIPPI.

The most important railway bridges of the sixth decade provided for the passage of trains over the Niagara river, a short distance below Niagara Falls, and over the Mississippi at Rock Island. It was evident that if such feats could be performed many other gigantic tasks were feasible.

The bridge across Niagara river was built by John A. Roebling, in 1854, on the suspension principle, and it attracted scarcely less attention and admiration at that time than the famous Brooklyn bridge, when it was finished under the direction of his son, substantially in accordance with his theories. The Niagara bridge demonstrated that serviceable railway suspension bridges of long spans could be constructed, notwithstanding the prevalence of a different opinion, but methods of construction which are considered preferable have been devised and almost universally adopted. The length of the Niagara bridge from centre to centre of tower was 821 feet 4 inches; elevation above mean water was 245 feet, and the depth of the river was 200 feet. Four wire cables were used, of an ultimate strength of 12,000 tons. The cost of the bridge was $400,000. The final report of Mr. Roebling, in describing its capacity, said: "The trains of the New York Central, and Canada and Great Western railroads have crossed regularly at the rate of thirty trips per day for five months. A load of 47 tons caused a depression at the centre of 5½ inches. An engine of 23 tons' weight, with four driving wheels, depressed the bridge at the centre 0.3 feet. The depression immediately under the engine was one inch, the effect of which extended one hundred feet. The depression caused by an engine and train of cars is so much diffused as scarcely to be noticed. A load of 326 tons produced a deflection of 0.82 feet only. The specified test for the wire was that a strand stretched over two posts, 400 feet apart, should not break at a greater deflection than 9 inches; also, that it should withstand bending square and rebending over a pair of pliers without rupture. This test corresponds to a tensile strain of 90,000 pounds per square inch, or 1,300 pounds per wire of 20 feet per pound."

THE ROCK ISLAND BRIDGE.

Probably the bridge of the decade which exerted the most important influence on the transportation systems of the country, and on the general subject of the relations between rail and water carriers, so far as a conflict of interests arose between them in connection with the bridging of navigable rivers, was a bridge built between the years 1853 and 1856 to connect the Chicago and Rock Island in Illinois with the Mississippi and Missouri Railroad (which subsequently was consolidated with the Chicago and Rock Island) in Iowa. It was the first railway bridge across the Mississippi. The route, as located, extended over Rock Island, then a military reservation. The only authority for the erection of the bridge consisted of an act of the legislature of Illinois and the purchase of the rights of the land owner on the western bank of the river, in Davenport, Iowa, to which the bridge was extended. This absence of definite authority from either the state of Iowa or the United States government, and numerous complaints of steamboat captains and owners, that the bridge seriously obstructed the navigation of the river, led to a protracted agitation in the courts and in Congress, which finally culminated in the adoption of a definite policy, by Congress, in reference to the bridging of the Mississippi, about ten years after this bridge was completed, and the passage of an act providing that the first Rock Island bridge should be taken down and supplanted with a new bridge to be erected at the joint expense of the United States and the Chicago, Rock Island and Pacific Railroad Company,—a change of structures which was finally completed in 1872.

The following description of the original bridge at Rock Island is embraced in an official report of the United States army engineers, made in 1859: "The railroad bridge is placed at the foot of the rapids, and is thrown from the island of Rock Island to the city of Davenport, Iowa. It is supported by two stone abutments on the shores and six stone piers. The spans (five in number) are 250 feet broad, the draw-spans being at the water level (9½ feet stage) 117 and 112 feet, respectively, making the whole length of the bridge 1,535 feet.

The piers, except those at the draws, are 35 feet long and seven feet broad at top, and 53 feet long and 11 feet broad at the bottom. The two small draw-piers are 38 feet long and 10 feet broad at top, and 54 feet long and 14 broad at the bottom. The turn-table pier, including the guard-pier and starling, is 355 feet long and 40½ feet broad at the top, and 386 feet long and 45 feet broad at the bottom.

This pier is composed of a stone centre pier 35 feet in diameter at the top, the remainder being crib-work filled up with stone. The up-stream starlings of all the piers are isosceles, right-angled triangles. The centre line of the roadway crosses the turn-table pier 210 feet from its head; this pier being 115 feet longer and 19 feet wider on top than the truss which forms the draw. The superstructure of wood, built upon Howe's patent, is 20 feet above ordinary high and 33 feet above ordinary low water."

CONSTRUCTION OF RAILWAY TUNNELS.

ONE of the outgrowths of the vigorous efforts during the sixth decade to complete railways leading westward from the Atlantic seaboard to the Mississippi valley, across the intervening mountain barriers, was the construction of a large number of tunnels, and the prosecution of important work on some extensive tunnels which had been commenced before 1850, and others which were not finished until after 1860.

The elaborate and highly creditable work on tunneling by Henry S. Drinker, E. M., published by John Wiley & Sons in 1878, contains many interesting particulars in regard to the railway and other American tunnels up to that period, as well as an interesting history of tunneling in all ages and countries. In discussing tunnels in this country previous to 1850, it states that up to that time 52 had been constructed, of which "7 were on canals, 16 on the Croton Aqueduct, and 29 on railways; 48 of them were commenced and completed prior to 1850, and in the second quarter of the century. The Factoryville tunnel, on the Delaware, Lackawanna and Western Railroad, built in 1850–52, opened tunnel construction in the decade from 1850 to 1860, during which so many railroad tunnels were built. . . . From this time on, of course, tunnels multiplied with railroads, and so many were built that it would be tedious to cite them in detail here. It is interesting to note, however, that no canal tunnels have been built in the United States since 1838, and that the decades from 1850 to 1860, and 1870 to 1880 have been the most active in railroad-tunnel construction."

OF THE RAILWAY TUNNELS COMPLETED BEFORE 1850,

the first was on the Allegheny Portage Railroad, and the second, the Black Rock tunnel, on the Philadelphia and Reading Railroad, to which reference has already been made. The third railway tunnel in the United States, in the order of commencement, (1835–38,) was the Elizabethtown, on the line of the Harrisburg, Portsmouth, Mt. Joy and Lancaster Railroad, which now forms part of the Pennsylvania Railroad, but it was not completed as soon as the Harlem tunnel, on the New York and Harlem Railroad (1836–37). These were each works of considerable magnitude for that period, the Elizabethtown tunnel (which has since been all taken out as open cut) being 900 feet in length, and the Harlem tunnel 844 feet in length. During the period intervening between 1837 and 1850 the tunnels completed included three on the Philadelphia and Reading system, five on the Baltimore and Ohio Railroad, one on the Lehigh and Susquehanna, one on the Albany and West Stockbridge, two on the Boston and Albany, and one on the New York and New England. The tunnels commenced but not finished before 1850 included one on the Rensselaer and Saratoga Railroad, ten on the Hudson River, and one on the Baltimore and Ohio.

The longest railway tunnel completed before 1850 was the Doe Gully, built by the Baltimore and Ohio, about sixty miles west of Harper's Ferry, constructed in 1839–41, which was 1,207 feet in length. The Kingwood, on the Baltimore and Ohio, 4,100 feet in length, was commenced in 1849, but not finished until the sixth decade.

FROM 1850 TO 1860,

in addition to a large number of tunnels varying from a few hundred to several thousand feet in length, the following tunnels, exceeding three thousand feet in length, were commenced, viz.:—

Sand Patch tunnel, on Pittsburgh branch Baltimore and Ohio, in Somerset county, Pennsylvania, through Sand Patch summit, built 1854–71, 4,725 feet in length, cost $375,000.

Stump House tunnel, on Blue Ridge Railroad, in Pickens district, South Carolina, built 1855–58, 5,865 feet in length.

Blue Ridge tunnel, on Chesapeake and Ohio, 121 miles west of Richmond, Virginia, built 1850–57, 4,262 feet in length, cost $488,000. Lewis tunnel, on Chesapeake and Ohio, 220½ miles west of Richmond, Virginia, built 1858–73, 4,033 feet in length, cost $400,000. Allegheny tunnel, on Chesapeake and Ohio, 223 miles west of Richmond, Virginia, built 1864–70, 4,711 feet in length.

Oxford or Van Nest Gap tunnel, on Warren Railroad, in Warren county, New Jersey, built 1854–62, length 3,006 feet.

Bergen or No. 1, on Erie Railway, through Bergen Hill, in Jersey City, built 1855–61, 4,388 feet in length, cost $800,000.

Allegheny or Summit tunnel, on Pennsylvania Railroad, Western division, summit Allegheny mountains, built 1851–54, length 3,612 feet.

Hoosac tunnel, on Troy and Greenfield Railroad, in Massachusetts, built 1854–76, 25,081 feet in length, cost $10,000,000.

The completion of these and many other shorter tunnels involved some of the most expensive, difficult, and dangerous work ever undertaken in connection with the construction of American railways. The cost of the tunnels varied from a rate of a little less than half a million of dollars per mile to from two to four times that sum, the cost of the Bergen tunnel being at the rate of about one million of dollars per mile, and of the Hoosac tunnel at the rate of nearly two millions of dollars per mile. Such outlays naturally had an important influence in increasing the average cost per mile of lines which sanctioned them.

INCIDENTAL FEATURES OF RAILWAY TUNNELS.

Aside from the cost of tunneling, serious disasters occurred at some points, including such as caused the death of workmen and led to protracted delays. There were instances, too, in which, on account of tunnels not being finished as soon as the connecting links of main lines, temporary tracks with exceptionally heavy grades were laid over the summits or hills being tunneled. One of the most notable of these was a track laid over the top of the hill on the east side of the Kingwood tunnel, on the Baltimore and Ohio, on a grade of 528 feet per mile, and on a curve of 300 feet radius, up which, it is said, a 25-ton, 8-wheel, coal-burning locomotive of Ross Winans' build propelled itself, tender, and a car-load of rails, weighing 15 tons of 2,000 pounds, at the rate of 10 or 12 miles an hour. It is stated that, although this exploit could easily be performed when the rails were dry and clear, when the rails were slippery the engine and its load would sometimes slide, with all wheels locked, down this grade.

In other cases, on account of the length of time required to complete tunnels, they were pressed into service before they were thoroughly arched, and, for this reason, expensive and troublesome labors subsequently became necessary. In other cases, the tunnels as originally built were not wide enough or high enough to meet modern requirements, and it was found necessary to enlarge them under difficult circumstances.

OF THE INHERENT DANGERS, DIFFICULTIES, AND ANXIETIES OF TUNNELING

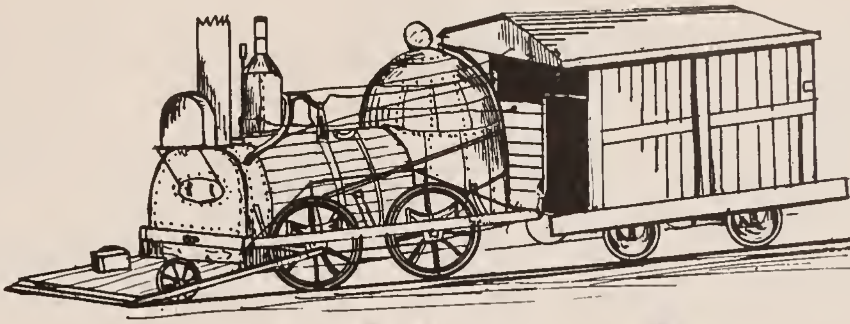
many details are given in Mr. Drinker's work. A note credited to B. H. Latrobe, appended to a description of the Broad Tree tunnel, on the Baltimore and Ohio, 39 miles east of Wheeling, which was 2,350 feet in length, and built in 1851–53, at a cost of $603,000, gives, in condensed form, a vivid picture of events connected with the construction of the tunnels of that road, which, to a considerable extent, resembled occurrences elsewhere, although other roads were generally more fortunate. It is as follows:—

"Broad Tree Tunnel. To expedite the laying of the track, a temporary road was made in October, 1852, over the top of the ridge, which is some 300 feet above the railroad grade. The hill being so high and also very steep, it was necessary to resort to a system of switches by which the movement of the train was reversed at the angles of the zigzag line which had to be adopted. There were two of these on the east and five on the west side of the ridge, making in all seven. The extreme grade was 1 in 20 feet, about 264 to the mile on a curve of 300 feet radius, equivalent to about doubling the resistance on a straight line. The Winans 25-ton engine propelled two loaded cars of 15 tons (of 2,000 pounds) up this grade with ease, and at times three cars. This mode of surmounting the hill was projected and executed by Benj. H. Latrobe, chief engineer. The track over the hill, though abandoned on the completion of the tunnel, was subsequently restored when the arching was being done, and successfully and safely used in carrying the trains during interruptions from falls in the tunnel, and to avoid interference with the workmen; in this very greatly promoting the economy of the arching and the working of the road. The tunnel, after being opened for use, was well timbered, and for two or three years gave little trouble. It had been excavated 16 feet wide by 22 feet high for a single track, and the roof would have stood better for this reason, but it was in a seamy and friable slate rock, softer than that of the Kingwood tunnel, and the rock began to settle so heavily upon the timbers as to make them give way and endanger passing trains. It was, therefore, decided to arch the tunnel, which was done in 1856–57—the side walls being of stone, and the arch of brick. The treacherous character of the roof of this tunnel led to many accidents from falls, which not only blocked up the road, but cost many lives, and maimed many of the men. These casualties seemed confined more particularly to the miners and laborers; the bricklayers and mechanics generally escaped injury. By the falling of a slab from the roof five men were crushed to the floor at once. These slabs, which had settled upon the tunnel supports, had often to be blasted while resting on the wood work, which they often, indeed generally, brought down with the explosion. The arching also was done by the company by day's work, and this and the numerous interruptions and accidents attending it will account for its excessive cost. This remark will apply to all of the tunnels upon the Baltimore and Ohio Railroad and its Parkersburg branch. Had the tunnels been arched immediately after the excavations were made, the cost of arching would probably have been less then it was in the proportion of from 1:1½ to 1:6 Thus the Paw Paw tunnel, which, being of a very soft shale rock requiring immediate protection, was arched at a cost of $22.62 per foot vein; and the Doe Gully tunnel, which was arched shortly after the road was opened, but with a light business, was arched for $22.52 per running foot, including the walling of its shafts. It had a better roof than the other, and, being longer, the cost of its portals bore a smaller proportion to its entire cost. These two tunnels were also arched by *contract*, the Paw Paw with the contractors for the excavation, and the Doe Gully with other competent contractors. The other tunnels which required arching upon the Baltimore and Ohio Railroad were, on the other hand, arched after a lapse of from two and a half to six years from the opening of the road, with a much heavier business than in the case of the two first tunnels just mentioned, and the cost was, therefore, vastly increased, as it embraced the support of the excavations mostly in friable slate rock by heavy timbering subject to rapid decay. Much of the fallen material had to be removed, and a large proportion of it required to be blasted to make it capable of being handled, and the explosions were often destructive of the timber supports.

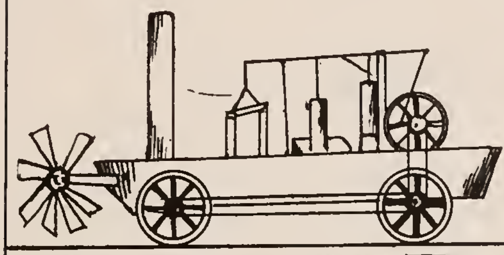
The delays from frequent passage of trains and from the smoke of the engines was a large element of cost, and the difficulty of maintaining a supply of suitable skilled labor in the face of perpetual risk of life and limb, was, as may be supposed, most serious. Under these circumstances, it is not to be wondered at that the cost of some of the tunnel-arching on the Baltimore and Ohio Railroad went up as high in one case as $134 per foot run, or about six times the average of the Doe Gully and Paw Paw tunnels, the latter also being arched (in 1840–42) when prices of labor and materials were much lower than in 1855 to 1869. The *average* cost of *arching* all the tunnels, except the Doe Gully and Paw Paw, upon the Baltimore and Ohio Railroad, between Baltimore and Wheeling, was $77.31 per running foot, or a total of $955,990 for 12,379 linear feet. The cost of *excavation*, including the Doe Gully and Paw Paw, ranged from $22.74 up to $106.40 per foot run, according to character of rock, length of tunnel, and circumstances attending the work, the average being $70.83 per foot linear, or a total cost of $979,979 for 13,826 of their total length. The arching of all the tunnels upon the Baltimore and Ohio Railroad, between Baltimore and Wheeling, was completed on February 1st, 1859. The arching of all the tunnels, except Everett's, was done under the immediate direction of the masters of the road, W. Bollman and John L. Wilson, and their assistants, some of whom had been previously the assistants of the chief engineer, who had retired shortly after the work was commenced. The road officers acquitted themselves with great credit in executing this difficult work."

INVENTION OF MACHINE DRILLS.

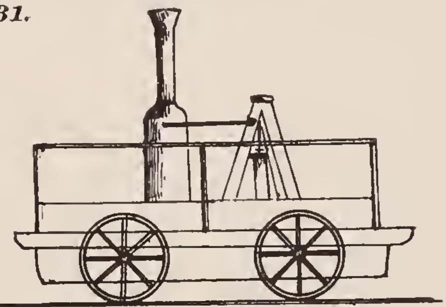
On the Hoosac tunnel, which proved to be the most expensive of American railway tunnels, considerable work was done during the sixth decade, and yet not enough to form a large proportion of the labors necessary to insure its completion. Various causes led to protracted delays, one of which was an enormous discrepancy between the estimated and actual cost of the work, and another, financial questions connected with the assumption of the heavy responsibilities it involved by the commonwealth of Massachusetts. The original estimate of its probable cost was less than two millions of dollars, or about one-fifth the sum actually expended. This calculation was made in 1851, and contains a reference to steam drills, from the use of which a material reduction in cost was anticipated. Inventive effort of the character indicated had been greatly stimulated by the agitation of the Hoosac tunnel project. The early contractors made strenuous efforts to avail themselves of some of the new devices, but the results were not satisfactory. It was, nevertheless, true that the possible utility of drilling machines had been demonstrated by the invention in 1849, by J. J. Couch, of Philadelphia, of the first promising labor-saving machine for drilling rocks. In the same year a caveat for an improved rock-drilling machine was filed by J. W. Fowle, who had assisted Mr. Couch in the construction of his drill. Of these two inventions, Mr. Drinker says that Fowle's "was really the precursor of the rock-drill as we now know it. To Couch belongs the honor of designing the first percussion drill as distinguished from a rotary borer, and to Fowle we owe the direct-action principle." These inventions were the first to clearly indicate the practicability of the advantageous application of machinery to rock-drilling, and by the numerous improvements which have since been made upon them, and additional devices, together with the discovery of improved explosive compounds, the art of tunneling has been revolutionized. But comparatively few, if any, important advantages were derived from either of these sources by the contractors engaged in constructing American railway tunnels during the sixth decade. Ma-



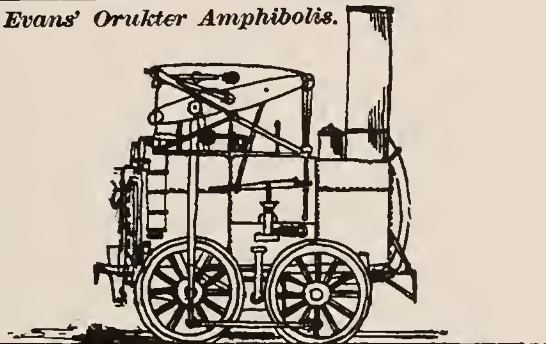
The John Bull, 1831.



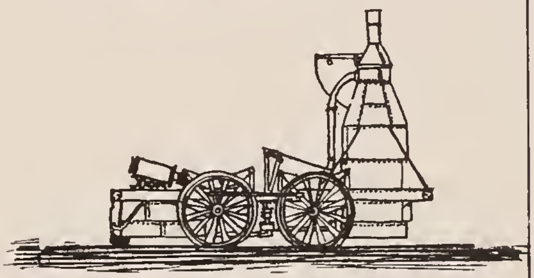
Evans' Orukter Amphibolis.



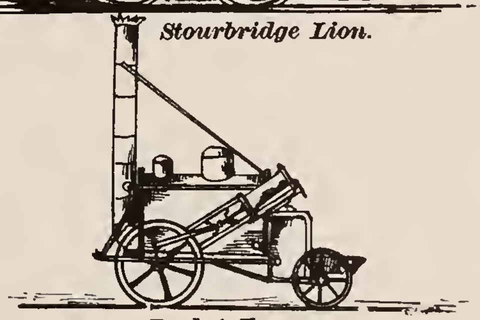
Peter Cooper's Locomotive.



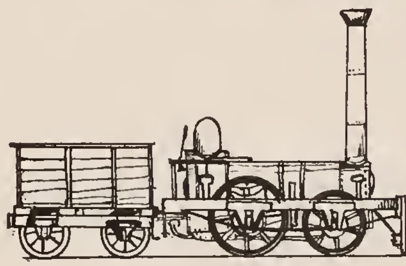
Stourbridge Lion.



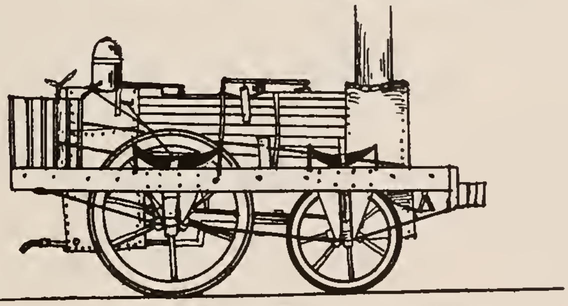
The Best Friend.



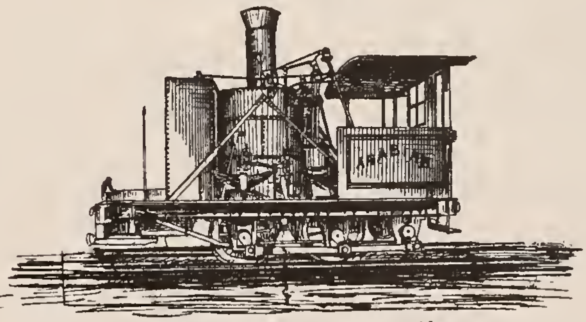
Rocket Type.



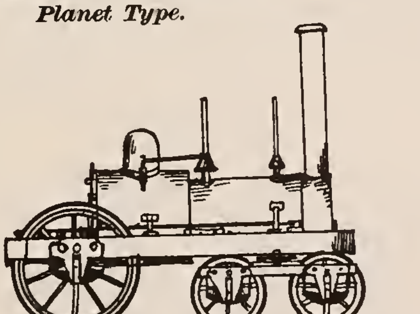
Old Ironsides.



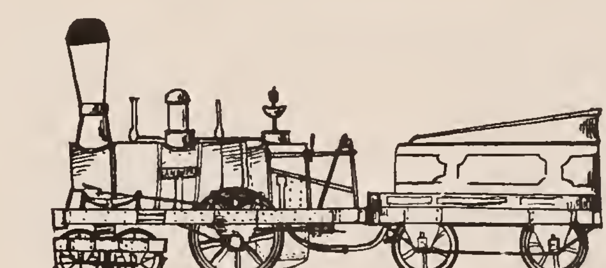
Planet Type.



Early B. & O. Locomotive.



First Bogie Locomotive



First Rogers Locomotive.

EARLY LOCOMOTIVES.

chine drills were then in an experimental stage, and dynamite had not been introduced.

AMERICAN SYSTEM OF BLOCK-TIMBER ARCHING.

Considerable changes in details of the methods of timbering tunnels were progressing during the sixth decade which gradually led to the establishment of what Mr. Drinker, in his work on tunneling, terms the American system of block-timber arching. He says that "American tunneling, as a system, is not universally recognized as such, nor is it generally known, especially in Europe, that we have here as distinct and marked a national system, that has been gradually developed out of the natural circumstances affecting the work as any of the English, Belgian, French, or German and Austrian systems can be said to be distinct, separate methods of timbering." Of the origin of the American system proper he says: "So far as it can now be determined, the variation from three rafter pieces to block-timber arching was first made by the late Mr. James Archbald, chief engineer of the Delaware, Lackawanna and Western Railroad, in the construction of the Oxford or Van Nest Gap tunnel, in New Jersey, in 1854; it proved most successful, and subsequently has been used in the construction of so many tunnels, throughout all parts of the country, that it has become, in fact, the national system of tunnel timbering."

IMPROVEMENTS OF LOCOMOTIVES AND CARS.

COAL-BURNING LOCOMOTIVES.

THE problem of substituting coal-burning for wood-burning engines attracted much attention during the sixth decade, but on only a very small proportion of the locomotives then in use, the number of which was estimated at about 9,000, had the changes necessary to render them economical and effective coal-burners been made. We are apt to forget that the use of coal as a fuel for domestic and miscellaneous purposes was much less common then than now, for, while the population has about doubled, the quantity of coal annually mined and consumed is about six times as great now as it was then, and most of the railways followed the general custom in continuing to burn wood in their locomotives. It was, however, considered a demonstrated fact that a ton of average bituminous coal furnished as much available fuel as $1\frac{3}{4}$ cords of average wood, and at many places a ton of coal was decidedly cheaper than $1\frac{3}{4}$ cords of wood. On the other hand, the use of coal necessitated more frequent and more expensive repairs than were usual on wood-burning engines. Nearly all the locomotives had been built to burn wood, and alterations were generally necessary to convert them into coal-burners, and the firemen, locomotive engineers, and locomotive manufacturers of England had at that time acquired greater familiarity with the requirements necessary to insure an effectual and economical use of coal than was then common in this country. Considerable progress had been made, however, on some of the important American lines, especially in Pennsylvania and on the Baltimore and Ohio, in the direction indicated, but even at the present day much of the heat-producing power of the coal used on locomotives is unnecessarily wasted. Aside from the change in fuel, the locomotive was growing in weight and capacity, as in previous decades, and a successful anthracite passenger engine had been built in the Reading shops by James Millholland.

In connection with these coal-burning difficulties, it should be stated that they related more particularly to anthracite coal, and to inferior and particular descriptions of bituminous coal, than to superior qualities of bituminous coal. There is much practical force in the following reference to this subject in a catalogue of Baldwin's Locomotive Works: "The result of experience and study had meantime satisfied Mr. Baldwin that to burn soft coal successfully required no peculiar devices; that the ordinary form of boiler, with plain fire-box, was right, with perhaps the addition of a fire-brick deflector, and that the secret of the economical and successful use of coal was in the mode of firing, rather than in a different form of furnace."

GRAPHIC DESCRIPTION OF SOME OF THE EARLY COAL-BURNING EXPERIMENTS.

Shortly after the retirement of Mr. S. M. Felton as president of the Philadelphia, Wilmington and Baltimore, in 1865, he was the recipient of numerous evidences of esteem and respect from his former associates and public-spirited citizens generally. One was a service of solid silver plate, valued at $6,000. The committee which had the presentation of the last-named gift in charge adopted a series of resolutions awarding to Mr. Felton credit for frustrating the plot to assassinate President Lincoln, while he was on his way to Washington, a short time before his inauguration, and opening the Annapolis route to Washington in April, 1861. Another was a miniature locomotive and tender, made of gold and silver, which were exact models of the "Webster," an engine alleged to be the first really successful one for burning coal on passenger trains, the construction of which was the final outcome of prolonged efforts made at the instance of Mr. Felton. His own experiences and statements on this subject, as stated at the time of the presentation of the models to him, which was on September 9th, 1865, furnish such an instructive illustration of the struggles that preceded the success finally achieved, that we republish a portion of his speech here:—

"This beautiful and exact model of the first really successful locomotive for burning coal on passenger trains, is an appropriate and touching memorial, for it will always remind me of my trials, as well as my final success in that department. Many years ago, while I was upon the Fitchburg Railroad, I came to the conclusion that if railroads multiplied in the future as they had in the past, our beautiful and green hillsides would be stripped of their foilage, and become barren wastes, unless some other fuel than wood could be found for locomotives, and accordingly, in 1849, I got up a locomotive for burning coal. It succeeded, by a good deal of nursing, in making now and then a trip when all the circumstances conspired in its favor. It, however, served no really useful purpose, save as a scarecrow to those who furnished wood, persuading them, through their fears, that it was or would be a success, to reduce the price of wood at once fifty cents a cord. So far, so good, but it was not a success as a coal-burner. It only paved the way to better things.

I see opposite me Mr. Dimpfel, a gentleman to whom the railroad interests are greatly indebted for his untiring zeal and persistent efforts in introducing coal as a fuel for locomotives; for though his plans are not generally adopted, yet his efforts and his experiments turned the attention of railroad men to the subject, and gave an impulse to inventions and contrivances which did not stop till success was achieved. He was the pioneer in devising ways and means of making coal a successful fuel on passenger locomotives, but his reward, I am sorry to say, is as yet nothing more substantial than the consciousness of having done a good work.

In 1855 Mr. William A. Crocker, of Taunton, and myself built at our own cost and trouble a passenger locomotive for burning coal on Mr. Dimpfel's plan. We were very sanguine of its success, but the subject was comparatively new. Engineers and firemen were used to wood, and coal was black and dirty to handle, and there were a thousand prejudices to contend with. We obtained leave to try some experiments on the Worcester and Western railroads, as the locomotive was then in Massachusetts. Our second experiment there was with a very heavy passenger train, composed mostly of emigrants for Kansas. We proceeded successfully for twenty or thirty miles, and began to think the problem was successfully demonstrated, when the engine began to lessen its speed. The pulsations of its life grew less and less vigorous, till finally it came to a stand-still. Then it was that a storm of indignant rage was showered upon our heads by the delayed passengers. We were glad to retire from the crowd, and procure another engine to speed the emigrants on their way. Then we examined at our own leisure into the cause of this most mortifying failure. The damper had been imperfectly secured in its open position. The motion of the locomotive had jarred it down, so that no air could be admitted to the fire-box, and, of course, the fire went out, as any wood fire would have done. Our engine was condemned for this one failure, though it made successful trips before—afterwards in other places—and we sold it at a loss of about eight thousand dollars between us. Thus ended the second chapter. The effort to burn coal was not, however, abandoned, but resulted, after some time, in the building of the 'Webster,' of which this is a model.

The 'Webster' was from the start an entire success, never making a failure. Under the skillful management of Mr. William Stearns, the then master mechanic, and Mr. N. Goohin, the engineer, the 'Webster' at once took its place as the then most successful coal-burner. It ran at half the expense of a wood-burner of the same class, and made its time so regularly and uniformly with the great express train that the residents along the line were in the habit of setting their watches by its passage past their houses."

In addition to Mr. Dimpfel's boiler, various other devices were pressed upon the attention of purchasers of locomotives, and a number of inventors and nearly all the important locomotive works had given much attention to improvements intended to overcome the difficulties involved in the use of coal, and especially anthracite, as fuel.

INCREASE OF WEIGHT AND CAPACITY OF LOCOMOTIVES.

Illustrations of the tendency to increase the weight and capacity of locomotives, including an increase of ability to traverse steep grades and sharp curves, are furnished by the following extracts from the sketch of the Baldwin Locomotive Works:—

"In February, 1852, Mr. J. Edgar Thomson, president of the Pennsylvania Railroad Company, invited proposals for a number of freight locomotives of 56,000 pounds weight each. They were to be adapted to burn bituminous coal, and to have six wheels connected and a truck in front, which might be either of two or four wheels. Mr. Baldwin secured the contract, and built twelve engines of the prescribed dimensions, viz.: Cylinders 18×22; driving-wheels 44 inches in diameter, with chilled tires. . . . The 10-wheeled engine thereafter assumed a place in the Baldwin classification. In 1855–56, two of 27-tons weight, 19×22-inch cylinders, 48 inches driving-wheels, were built for the Portage Railroad, and three for the Pennsylvania Railroad. In 1855–56 and '57 fourteen of the same dimensions were built for the Cleveland and Pittsburgh Railroad; four for the Pittsburgh, Fort Wayne and Chicago Railroad; and one for the Marietta and Cincinnati Railroad. . . .

In 1853 Mr. Charles Ellet, chief engineer of the Virginia Central Railroad, laid a temporary track across the Blue Ridge, at Rock Fish Gap, for use during the construction of a tunnel through the mountain. This track was twelve thousand five hundred feet in length on the eastern slope, ascending in that distance six hundred and ten feet, or at the average rate of one in twenty and a half feet. The maximum grade was calculated for two hundred and ninety-six feet per mile, and prevailed for half a mile. It was found, however, in fact, that the grade in places exceeded three hundred feet per mile. The shortest radius of curvature was two hundred and thirty-eight feet. On the western slope, which was ten thousand six hundred and fifty feet in length, the maximum grade was two hundred and eighty feet per mile, and the ruling radius of curvature three hundred feet. This track was worked by two of the Baldwin 6-wheel connected flexible-beam truck locomotives constructed in 1853–54."

A description of the track and performances of the engines, written by Mr. Ellet, embraces these statements: "The regular daily service of each of the engines is to make four trips, of eight miles, over the mountain, drawing one 8-wheel baggage car, together with two 8-wheel passenger cars, in each direction. In conveying freight, the regular train on the mountain is three of the 8-wheel house cars, fully loaded, or four of them when empty or partly loaded. These three cars, when full, weigh, with loads, from forty to forty-three tons. Sometimes, though rarely, when the business has been unusually heavy, the loads have exceeded fifty tons. With such trains the engines are stopped on the track, ascending or descending, and are started again on the steepest grades, at the discretion of the engineer."

STANDARD PASSENGER CARS.

The passenger car of the sixth decade in general use had a body about fifty feet long, ten feet wide, and seven feet high, containing seats for about sixty passengers. The seats were cushioned, and the cars warmed, lighted, and ventilated. Many improvements in their construction and furniture were progressing, as it was a matter of rivalry with competing companies to make cars as attractive as possible.

An article on standard passenger cars, published in Colburn's Railroad Advocate, of May 31st, 1856, in enumerating the things then specially needed, included the following:—

"We do need a good car spring, and we hope and expect to find it in some one of the new forms of metallic springs soon to be brought on trial. We want a spring without the weight and bulk of the elliptic spring, and proof against the decay, early rigidity, and frequent failure of the rubber spring. The latter, especially, is becoming intolerable.

There are good mechanics yet busy in the improvement of oil-tight boxes. The metal for axle bearings is also a subject of much experiment now. We have seen a box composed of cast steel, copper, and tin. Attempts have been made, with some success, to use glass bearings.

Thorough ventilation is one of the most desirable points of improvement in cars. Ruttan has a philosophical and simple plan, but it involves making a water-tight bottom to the car, and probably raises the car body a trifle to clear the trucks. Foote partially avoids these assumed objections, and runs afoul of a worse one in the complications of a force pump. Still, either of these plans, when in their proper action, effect a thorough ventilation.

We need only speak of the competition in bringing out a good reclining seat to indicate the public sense of the need of such an improvement.

We must have a brake under instant control at the hands of the engineer, and capable of holding all the wheels of the train to the limit of sliding them on the rail. No brake must do more—no, nor quite so much as to slide the wheels. But the brake must be had, and if the fact that brakes now form the most engrossing field of inventive effort is worth consideration, we may soon expect a reliable automatic brake.

Regarding stoves, the inquiry has been universal for a good stove that would burn coal in passenger cars.

Self-acting couplers must come into use. Hopkins' coupling ought to go on every car, saving time in coupling, and, above all, obviating the need of sending men in between the bumpers.

In lighting, Moeller has given us a good lamp, if it keeps in order. It prevents the wick from jarring down, prevents all slop of oil, and burns the oil down to the last drop. Now, if any other substance than oil be used for light, kerosene, for instance, we shall perhaps gain a strength and diffusion of light highly desirable."

Colburn's Railroad Advocate, of July 19th, 1856, in describing new passenger cars, which had just been completed at the Piedmont shops for the Erie road, said:—

"These cars are not equaled in size, accommodation, or elegance of finish by any other public railroad conveyances in the world. . . . The body of the car is 60 feet 3 inches long outside, and 10 feet 9 inches wide. The posts are 7 feet high, and the height of the cars at the centre is about 11 inches greater than of any others now on the road. There are 20 windows on each side of the car, with a single plate of double-thick French plate glass, 17×21 inches in each. There are two windows also in each end. The car seats 74 passengers, including two in the saloon. . . . The seats throughout are C. P. Bailey's patent reclining, day or night seats. They are very large and easy, and splendidly upholstered, the covering being a rich velvet plush, costing five dollars a yard. The cars are ventilated on Foote & Hayes' patent plan, and an improvement has been made in working the pump, used in the ventilator, by a friction wheel on the axle. . . . The trucks and running gear, built by Harvey Rice, Esq., are well got up, and, although the same kind are already in use in other cars on the road, they are a novelty off the road. The axles are spread six feet apart centres, and have both outside and inside journals. The inside journals have grooved collars on each end, and are fitted with Harvey Rice's improved box. The axles are from the Brunswick works, England, and the wheels, 33 inches in diameter, are Bush & Lobdell's patent. The worst fault with the trucks is in using rubber springs, which, if they stand the great weight at all, will become frigid or freeze. . . . The entire weight of these cars is not far from eighteen tons, empty."

On some of the southern lines an expedient was occasionally adopted, similar to that employed on the early English lines, of making provision for fastening private carriages on platforms of freight cars, so that gentlemen could ride on the railway in their own conveyances if they desired to do so.

CAPACITY OF FREIGHT CARS.

The capacity of freight cars continued to be comparatively limited. Nine tons per eight-wheeled car, and four tons for four-wheeled cars, were considered heavy loads, and the system of construction was not deemed very satisfactory. The report of Joseph B. Baker, superintendent of the Philadelphia and Columbia Railroad, for the fiscal year ending November 31st, 1855, says: "Whether the present plan and construction of cars is the best adapted for the cheap and safe transportation of freight is very questionable. A long or eight-wheeled car is from twenty-eight to thirty-three feet in length; weighs, including the trucks 16,000 pounds, and is permitted to carry 18,000 pounds of loading. This loading, in addition to the weight of the box, is borne by two bolsters, each resting on a centre bearing or pivot. The weight being so great upon these two points, renders it difficult to construct bolsters sufficiently strong to carry the weight without bending." Mr. Baker also states that in moving 481,012 tons 196,939 cars were used, so that the average load was less than two and a half tons.

Although passenger-car construction had been improved, the cars in use on some lines fell so far behind modern standards that critical English travelers were apt to speak of some of the vehicles in which they journeyed over our roads as but little more than huge wooden boxes.

RAILWAY SUPPLIES—SHOPS AND TELEGRAPHIC SERVICE.

DURING the sixth decade large additions were made to the list of establishments in which rails, the superstructure of bridges, rolling stock, and various classes of railroad supplies were manufactured, and also to the number and facilities of railway shops. Various devices were materially improved, and the desirability of additional improvements was recognized by many companies.

RAILROAD IRON, CAR WHEELS AND SPRINGS.

The Census Report of 1860 on manufactures contains statistics which show that during the year ending June 30th, 1860, 235,107 tons of "railroad iron" were produced in the United States, exclusive of considerable quantities of iron classified under other titles which was probably used for railway purposes. Of car wheels it is stated that "they were made in 17 establishments, returned from 7 States, to the value, annually, of $2,083,350, which was the value of 142,000 car wheels. . . . The principal car-wheel factories are in the Middle States. Five establishments in the State of New York, at Troy, Albany, Rochester and Buffalo, made 30,000 car wheels, averaging nearly 5 to the ton, and valued altogether at $386,550. Four establishments in New Jersey, three of them in Jersey City and one in Warren county, turned out 18,000 car wheels, worth $271,800. Three factories in Pennsylvania employed a capital of $503,700 and 121 persons, and made 45,000 car wheels, valued at $613,000. The principal one at Philadelphia employed a capital of $490,000 and 100 hands, and manufactured 24,000 car wheels, which were cooled by a patent process, and valued at $270,000, besides 725 axles, worth $80,000. One factory at Hawley, in Wayne county, made 20,000 wheels, worth $250,000, and one in Columbia county, 1,000 wheels, valued at $13,000. The largest car-wheel factory in the United States was at Wilmington, Delaware, and had invested a capital of $200,000. This celebrated foundry consumed 10,000 tons of iron, and with 200 hands cast 30,000 car wheels, valued at $500,000, besides 1,000 chilled tires and 300 tons of other castings—a total value of $562,000. An establishment at Cincinnati, with 20 hands, made 1,200 tons of car wheels (about 6,000), valued at $75,000, and one at Chicago, 1,000 tons of car wheels, or 4,000 in number, worth $56,000." The form assumed by this car-wheel industry, consisting of a chilled iron rim or wearing surface exposed to the rails, is peculiarly of American development, and numerous improvements have been made from time to time in methods of manufacture.

Springs for cars, carriages, and locomotives were manufactured in 40 establishments, to the value of $2,117,377. Although made in 9 States, the principal values were produced in Connecticut, three of the Middle States, and Virginia. Of locomotives the report says:—

LOCOMOTIVE WORKS.

"Locomotives were manufactured in seven or eight states to the number of 470 or upward. The number of establishments engaged wholly or chiefly in this branch of machinery was 19, which together employed a capital of $3,482,592, and 4,174 hands. The value of the engines made was $4,866,900, an average of $10,355 each.

The largest value was made by four manufactories in New Jersey, from which were turned out 166 locomotives, valued at $1,565,000, of which sum $765,000 was the product of one of three factories at Paterson, which employed 720 men, and built 90 locomotives. The fourth shop was that of the Camden and Amboy Railroad Company at Bordentown, which made a few engines and a number of cars. Next to New Jersey came Pennsylvania, in which two large factories in Philadelphia, among the oldest and largest in the country, employed capitals, respectively, of $900,000 and $750,000. The largest, with 675 hands, constructed 89 engines, worth $750,000, and the other, with 800 men, turned out 79 locomotives, valued at $670,000. Two locomotives were built in Scranton, and two in Pottsville, the values of which are not included in the statistics of this branch. Five locomotive shops in Massachusetts built 54 engines, worth $643,000. The two largest were at Taunton, one of which, with 175 hands, built 23 locomotives, valued at $180,000, and the other, with 425 men, made $250,000 worth of cotton machinery and 14 complete locomotives, including the wheels, valued at $80,000. Others were manufactured at Worcester and Roxbury. Four shops in New Hampshire constructed 43 engines, valued at $805,900. The largest were two at Manchester, one of which, the machine department of the Amoskeag Manufacturing Company, employed 450 men, and turned out 37 locomotives, valued, with mill machinery and castings, at $695,000. The Manchester Locomotive Works, formerly extensively engaged in the business, built about 5 engines, worth $37,500, and the railroad shop, at Lake Village, a few locomotives and 32 cars. Another repaired engines and built 70 cars. An old locomotive establishment in Baltimore, not in full operation in 1860, built in that year about 6 engines, worth $50,000. Four railroad shops in Kentucky executed work of the value of $250,000, of which $235,000 was the value of about 10 locomotives, some cars and repairs made by one, and the balance chiefly repairing by the other. The greater part of the locomotives made in the country, however, are built by two shops in Boston, two in Taunton, three in Paterson, and two in Philadelphia. One at Portland, Maine, one at Baltimore, and perhaps one or more in the State of New York, built a few locomotives, but were chiefly engaged in other work."

SHOPS AND MACHINE TOOLS.

Another important development of the decade was the establishment of numerous railway shops, including the gigantic works at Altoona, and their equipment with machine tools and appliances for constructing, as well as repairing, rolling stock and various descriptions of railway supplies. The extent to which these works act as a bulwark or support of the entire railway edifice, or power behind the throne, and the degree in which railway effectiveness and prosperity depend upon the amount of wisdom displayed in shop operations, is not realized by the general public, who are more ready to detect imperfect service in the track, car, or locomotive than to inquire into the agencies by which safeguards against serious defects are provided, and a sufficient equipment always kept in working order. As the railway is a gigantic machine for pressing many kinds of machinery into the manufacture of facilities for transportation, it is peculiarly liable to an infinite variety of mechanical derangements, and railway shops, with their tools, and skilled artisans, and superintendents, form indispensable adjuncts. This fact received much more liberal and extensive recognition during the sixth decade than in previous periods; and the desire of sagacious railway managers to provide additional facilities for repairing and manufacturing was promptly recognized and effectively seconded by the proprietors of American works for manufacturing machine tools, which have since gained a world-wide reputation. The Census Report of 1860 on manufactures says: "Machinists' tools employed 17 manufactories, a capital of $536,150, and 455 hands, and the value of the manufacture was $540,292, of which $205,000 was the product of one establishment in Philadelphia, having a capital of $280,000 and employing 190 hands, and turning out machinists' tools of acknowledged excellence. Nine establishments in Massachusetts reported a value of $165,600 made, and two in New Haven, Connecticut, a product of $71,600. Three in New York made tools of the value of $47,950, one in New Jersey $2,800, and one in Delaware $22,142."

Indications of the imperfect nature of the shop appliances used on some of the early roads, and of the new kinds of machinery coming into use, are furnished by the following extracts from a report of Mr. J. B. Baker, superintendent of the Philadelphia and Columbia Railroad, for the year ending November 30th, 1855:—

"For some years the arrangement of the engine house at Philadelphia has been ill adapted for the accommodation of our large engines. The turn-table was not large enough to turn an engine and tank together, rendering the operation of turning laborious and tedious. Neither were the tracks long enough to hold the large engines with their tanks. To expedite the business of turning the engines it was considered necessary to put in a 50-feet turn-table, and lengthen the tracks by building additions 15×22 feet to the round-house, opposite the ends of the tracks. . . . The turn-table is made of cast iron, and manufactured by William Sellers & Co., of Philadelphia, with Parry's anti-friction box, or pivot, of which I cannot speak too highly. No gearing is required, and two men can turn the heaviest locomotive in one-third the time that half a dozen could with the old arrangement.

The Columbia shops are of considerable importance for repairing engines during the time they are laying at that end. *They have never had any suitable tools*, and I have been compelled to order a drill press for them, which will cost eight hundred and fifty dollars. The shops at Parkesburg require some additional tools this year. The repairing of engines has become so large an item in our expenses, and so important, that in all probability we will have to erect an addition next spring, to accommodate the coppersmiths, as the space they now occupy will be required for forge fires. The steam hammer, for which an appropriation was made last year, will be put up this month. The new tools required, and cost of each, are as follows:—

An engine lathe, with screw-cutting gearing	$350 00
Planing machine, 4½ feet by 24 inches wide	650 00
Bolt-cutting machine	400 00
And for building coppersmith shops	400 00
	$1,800 00"

Of mechanical operations on the Philadelphia and Columbia Railroad for some years after its construction, and up to a comparatively late period of its management by the state, a gentleman who acted as a locomotive engineer on the line during a large part of that period informed the writer that when locomotives needed repairs at either end of the line there was no provision for making them except such as was furnished by blacksmiths and helpers, who acted under the direction of the engineer, while at the Parkesburg shops, near the centre of the road, only a few machinists were employed.

USE OF THE TELEGRAPH AS AN AID TO RAILWAY OPERATIONS.

One of the new aids to effectiveness in railway operations, which has proved to be indispensable, that first came into general use during the sixth decade, was the free employment of the telegraph to forward orders in regard to train movements, &c. The New York Times gives the following account of the incident which is alleged to be the first resort to this exceedingly useful practice:—

"The year 1850 marked an era in railroad management, not only in this country, but in the world, for in that year it was successfully demonstrated that trains need not be run blindly from station to station, but that the telegraph could be made the means of directing them on their way. Up to that time it was the rule of trains going west on the Erie to run to regular stopping places, where they took the switch until the train running 'against them' from the west should pass, and *vice versa*, as locality made necessary. The train in the switch could not go on until the opposite train passed, and, consequently, delays of hour duration were common. One day in 1850, when Charles Minot was superintendent of the road, a passenger train from New York reached Turner's Station, where it was to wait for an east-bound train to pass. It did not arrive on its time. Superintendent Minot was on the train. He telegraphed to Port Jervis, and learned that the train had not reached that place yet. Then the idea struck him that he could run both trains by the telegraph, and save hours of delay to the west-bound train. He telegraphed to the agent at Port Jervis to hold the east-bound train when it arrived there until he heard from the superintendent. The latter then told the engineer of his train to go ahead, that they would run on telegraph signals. The engineer refused to take the risk. Superintendent Minot ordered him off the engine, and grasped the lever himself. He ran the train, telegraphing orders ahead at each station. The east-bound train reached Port Jervis, and was run to Otisville, twelve miles eastward, while the west-bound train was making its way westward at the same time on telegraph signals. At Otisville the east-bound train took the switch, and the other train passed it, reaching Port Jervis on time. This was the end of the old system of running trains, and was the origin of telegraphic signals in running railroad trains."

TONNAGE AND RATES IN THE SIXTH DECADE.

STATISTICS pertaining to railways affairs, previous to 1860, were comparatively incomplete and unsatisfactory. Even at the present day there is an absence of uniformity in the returns of the roads of different states, and in the reports of companies operating in given commonwealths, which frequently renders it difficult to obtain reliable data relating to aggregate results of any description. Before the sixth decade the laws of Massachusetts requiring definite statements relating to a variety of subjects, from each company, were exceptional; and the necessity of more comprehensive information than that available was beginning to be recognized. The fact that Massachusetts required such returns from the outset, and that they were widely circulated, may have had some influence in promoting the success of some of the important New England companies, as they presumably helped to inspire confidence, to decrease the difficulty of obtaining necessary capital, and to increase the probabilities of judicious and economical management. New York was one of the first states to follow the example of Massachusetts in requiring annual returns to a state official or department, but partly on account of the tardiness displayed by nearly all other commonwealths, and the strong disposition of some managements to adopt a "close corporation" policy, the records of early railway operations are necessarily incomplete.

In regard to

THE TONNAGE OF AMERICAN RAILROADS IN 1860

the information contained in the following extract from the preliminary report on the eighth census, shows the views then prevailing, and it will be seen that the calculation is largely based upon the returns made to the state governments of Massachusetts and New York:—

"It is well ascertained that our railroads transport in the aggregate at least 850 tons of merchandise per annum to the mile of road in operation. Such a rate would give 26,000,000 tons as the total annual tonnage of railroads for the whole country. If we estimate the value of this tonnage at $150 per ton, the aggregate value of the whole would be $3,900,000,000. Vast as this commerce is, more than three-quarters of it has been created since 1850. To illustrate the correctness of the estimate made, the following statement is added of the tonnage transported by the railroads of the state of New York for 1860, with the estimated value of the same. The classifications are made by the companies:—

Kinds of freight.	Tons carried.	Value per ton.	Total value.
Products of the forest	373,424	$20 00	$7,468,480
Products of animals	895,519	200 00	179,103,800
Vegetable food	1,103,640	50 00	55,182,000
Other agricultural products	143,219	15 00	2,148,055
Manufactures	511,916	250 00	127,979,000
Merchandise	783,811	500 00	391,905,500
Other articles	930,244	10 00	9,302,440
	4,741,773	$163 00	$773,089,275

If we make a deduction of one-quarter for duplications—a portion of the tonnage passing over more than one road—the aggregate would be 3,556,330 tons, having a value of $579,681,790.

The railroads of Massachusetts transported for the same year 4,094,369 tons; or, making the deductions for duplications, 3,070,027 tons, and having a value of $500,524,201. The number of miles of railroad employed in the transportation of freight being 2,569 in the state of New York, and 1,317 in the state of Massachusetts, with the deductions named, the amount of freight transported in these states average 1,700 tons per mile. We have estimated the tonnage of all the railroads of the United States to average one-half the amount of the roads in these states. That this is not an overestimate is shown by the following statement of the tonnage of several interior lines:—

Roads.	Length of miles.	Tons transported.
Cleveland, Columbus and Cincinnati	141	295,835
Little Miami	120	343,961
Cleveland and Toledo	147	250,483
Michigan Central	282	378,570
Michigan Southern	525	398,679
Illinois Central	700	496,390
Chicago, Burlington and Quincy	310	538,670
Chicago and Rock Island	228	301,668
Galena and Chicago	259	381 188
Total	2,712	3,386,393

Average per mile 1,250 tons."

RAILWAY RATES IN THE SIXTH DECADE.

Judged by modern standards the business of the trunk lines and other leading railways, previous to 1860, was of very limited proportions, and the average freight rates high, but the actual transactions represented a remarkable advance on any of the railway operations of preceding periods.

The great utility of through lines as freight carriers consisted largely in their transportation of merchandise westward, and the east-bound movement of freight possessing greater value per ton than grain, such as live stock. Strenuous efforts to carry flour eastward at low rates, however, were made, and this was probably the first comparatively cheap article moved over long distances in which successful competition with the canals was established.

The first continuous line of railway to connect the lakes and tide-water was that from Albany to Buffalo, now the New York Central. It closely followed the route of the canal, and as it was considered a competitor of the state works, the canal tolls were imposed upon all freight it carried, in addition to the railway charges. The state derived a large revenue from this source. The tax had a strong tendency to confine the freight business of the railroad to the less bulky and more valuable or perishable articles. Andrews' report, made in 1852, says: "The tax was removed on the 1st of December, 1851, by an act of the legislature; hence the road is now brought into free competition with the canal, and has, during the present season, carried flour from Buffalo to Albany for sixty cents per barrel, which is *nearly fifty cents below the average price by canal for nearly twenty years subsequent to its opening.*"

In referring to New England roads, Andrews' Report of 1852 says:—

"The distance from Boston to Ogdensburg is about 425 miles. The rates charged for the transportation of a barrel of flour between the two places have ranged from sixty to seventy-five cents per barrel, which is less than the cost on the Erie Canal for the same article from Buffalo to Albany (a distance of 363 miles) for many years after its opening."

The tonnage tax imposed by the legislature of Pennsylvania upon the Pennsylvania Railroad had an important influence in restricting its early operations as a through freight carrier, analogous to that arising in New York from the state tolls imposed on the New York Central.

In S. W. Roberts' lecture on the Portage road he says: "The charter of the Pennsylvania Railroad did not authorize the use of the Portage Railroad, as the legislature was afraid of competition with the main line of the public works. There was also a tonnage tax imposed, to protect the business of the main line during the season of canal navigation, which was at the rate of five mills, or half a cent, per ton per mile, between the 10th of March and the 1st of December in every year, but the railroad was to be free from the tonnage tax in what was considered to be the winter season. Although this tax was modified, it was not abolished until after the purchase of the main line by the Pennsylvania Railroad Company."

Even the managers of roads exempt from such exactions could not then have regarded the reduction of freight charges to the low figures subsequently reached as a possibility. The prevailing sentiment in railway circles shortly before the close of the sixth decade is typified by the fact that at a convention held in New York, attended by officers of the four great lines between the Atlantic and the west, a joint report was submitted by the superintendents of the several roads, in which they state that "experience has proved that *the lowest rates* at which ordinary freight can be carried to pay interest and expenses will average about two cents per ton per mile for heavy agricultural products, three cents for groceries, and four cents for dry goods." At a subsequent convention of the railroad companies of Ohio and Indiana similar resolutions were adopted.

On the railways of the state of New York in 1855, the average receipts per passenger per mile were 1.95 cents; per ton of freight, 2.79 cents; per passenger or per ton, 2.38 cents; expenses, 1.38 cents.

About 1855 the average cost of passenger transportation in Massachusetts was 1.062 cents per passenger per mile, and the cost of merchandise transportation, 3.095 cents per ton per mile.

There are few, if any, reports of any extensive railway movements during the sixth decade at a lower rate than 1½ cents per ton per mile, and it was considered remarkable that, in connection with the movement of agricultural products in the Western states, the competitive railways of that region adopted that rate, which seems to have been the "cut rate" of the period.

In October, 1853, Henry C. Carey wrote as follows: "Agreeably to a table now before me, when corn is worth at market $24.75 per ton, it is worth nothing at a distance of only 160 miles when it is required to be carried by a wagon, because the cost of transportation is equal to the selling price. By railroad, *where competition exists, the cost of transporting the same ton is set down at $2.40, one and one-half cents per ton per mile*, and there remains to the farmer $22.35, the amount of tax that he is saved by the construction of the road."

The tonnage of the Philadelphia and Reading Railroad, which probably carried a greater number of tons of freight during the sixth decade than any other railway in the United States, consisted in 1859 of 1,632,932 tons of coal and 334,609 tons of merchandise. The number of passengers was 379,406, of whom 126,076 were through passengers. The gross receipts were $1,883,685 for coal transportation, $479,888 for transporting merchandise, and $365,720 for carrying passengers, the mail, &c.

TRAFFIC AND RATES OF THE TRUNK LINES AND THEIR WESTERN CONNECTIONS.

The tendency towards a reduction of average freight rates, and an increase of tonnage on the trunk lines and their western connections is shown by the following statistics:—

Years.	Tons of freight moved.	Tons moved one mile.	Per ton mile. Earnings. Cents.	Per ton mile. Expenses. Cents.	Per ton mile. Net. Cents.	Earnings from freight.
PENNSYLVANIA RAILROAD AND BRANCHES.						
1855..	356,006	102,171,312	2.746	1.662	1 084	$2,805,306
1856..	454,092	119,836,501	2.707	1.662	1.045	3,244,292
1857..	826,518	139,994,548	2.411	1.536	0.675	3,374,041
1858..	1,046,899	162,121,735	2.181	1.289	0.892	3,536,206
1859..	1,170,240	180,333,140	2.027	1.176	0.851	3,656,111
NEW YORK CENTRAL.						
1854..	549,805	99,309,600	2.954	1.309	1.645	$2,943,966
1855..	670,073	114,827,792	3.270	1.341	1.929	3,755,320
1856..	932,844	165,819,708	3.046	1.542	1.504	5,052,059
1857..	1,075,589	165,515,934	3.187	1.698	1.489	5,275,876
1858..	925 604	161,103,043	2.635	1.374	1.261	4,244,639
1859..	1,093,284	187,291,130	2.162	1.281	0.881	4,049,530
NEW YORK, LAKE ERIE AND WESTERN.						
1852..	456,460	96,697,695	1.948	1.026	0.922	$1,883,198
1853..	631,039	101 626,522	2.496	1.277	1.219	2,537,215
1854..	743,250	130,808,034	2.576	1.406	1.170	3,659,590
1855..	842,055	150,673,997	2.424	1.155	1.269	2,653,002
1856..	983,221	183,458,043	2.477	1.169	1.308	4,545,722
1857..	978,067	165,100,850	2.457	0.897	1.560	4,097,610
1858..	816,964	165,895,636	2.316	0.649	1.667	3,843,310
1859..	869,072	147,127,039	1.621	1.344	0.277	3,195,869
PITTSBURGH FORT WAYNE AND CHICAGO.						
1857..	304,769	28,893,960	2.27	1.57	0.70	$567,686
1858..	285,663	35,168,323	1.90	1.32	0.58	667,269
1859..	362,606	58,421,205	1.65	1 18	0.47	693,995

On the Lake Shore and Michigan Southern 43,304 tons were forwarded from Chicago, in 1858, at an average rate of 2.380 cents per ton per mile; and 69,088 tons were forwarded from Chicago in 1859 at an average rate of 2.292 cents per ton per mile.

MISCELLANEOUS TRANSPORTATION DEVELOPMENTS.

POST ROUTES IN 1850 AND 1860.

FEW things illustrate more forcibly the nature of important transportation changes during the sixth decade, the increase of railway utility and mileage, and the rapidity of various kinds of progress than the post routes of the years 1850 and 1860. Statistics bearing on this subject include the following:—

	Railroad routes, miles.		Steamboat routes, miles.		Turnpike and other road routes, miles.		Total length in miles.	
	1850.	1860.	1850.	1860.	1850.	1860.	1850.	1860.
Maine	...	494	....	....	....	....	4,284	4,416
N. Hampshire.	...	429	....	60	....	1,219	2,213	1,780
Vermont	...	489	....	....	....	1,732	2,519	2,221
Massachusetts..	...	1,297	....	240	....	1,185	3,241	2,722
Rhode Island..	...	109	....	28	....	....	434	363
Connecticut...	...	745	....	260	....	....	1,852	1,963
New York	1,191	2,893	989	160	11,217	7,890	13,397	10,951
New Jersey....	217	455	28	12	2,092	1,679	2,336	2,146
Pennsylvania..	458	1,568	....	85	10,964	11,465	11,422	13,118
Delaware	...	85	....	....	488	454	488	539
Maryland	416	843	....	....	2,022	2,100	2,438	2,943
Virginia	296	1,360	610	637	11,017	11,748	11,923	13,745
North Carolina.	247	648	282	132	7,402	8,301	7,931	9,081
South Carolina.	247	1,054	880	175	4,327	4,269	5,464	5,498
Georgia	668	1,284	358	332	5,995	5,125	6,921	6,741
Florida	23	142	280	1,860	2,304	2,328	2,607	4,330
Alabama*	...	....	....	....	....	....	7,004	7,803
Mississippi	59	693	75	276	5,326	7,296	5,460	8,265
Louisiana	...	304	1,195	1,895	2,956	5,612	4,151	7,811
Tennessee	...	833	....	21	7,371	7,087	7,371	7,941
Arkansas	...	....	....	1,134	....	....	5,463	11,723
Texas	...	78	80	2,185	7,618	16,193	7,698	18,456
Kentucky	...	379	140	140	6,978	7,763	7,118	8,282
Ohio	280	3,401	439	187	11,548	9,267	12,267	12,855
Michigan	344	937	424	725	4,420	5,178	5,188	6,840
Indiana	104	1,509	...	....	7,158	6,451	7,262	7,960
Illinois	...	2,591	....	100	10,314	7,606	10,314	10,297
Wisconsin	...	907	....	60	4,572	5,467	4,572	6,434
Iowa	...	140	....	379	3,664	7,313	3,664	8,232
Minnesota	...	....	270	620	419	4,598	689	5,218
Missouri	...	440	1,156	659	8,546	13,385	9,702	14,484
Kansas	...	....	....	....	....	....	....	5,722
California	...	22	260	290	3,469	4,880	3,729	5,192
Oregon	...	....	130	121	405	500	535	631
W. Territory..	...	....	....	340	....	416	....	756
Nebraska	...	....	....	....	....	....	....	1,772
Utah	...	....	....	....	....	....	....	1,450

* Exclusive of railroads.

PLANK ROADS AND STREET RAILWAYS.

There were two developments of the sixth decade which had widely different destinies. One was a furore in favor of the construction of plank roads, of which scarcely a trace is now left, on account of the perishable nature of the materials used, and the other was a vigorous start towards the construction of city passenger street railways, which has been followed by large additions to the number of such enterprises.

Plank roads were in some states designed to serve as feeders of steam railroads, or, at all events, to act as decided improvements of the roads leading to railway stations, and sanguine expectations of their utility for such purposes were at one time cherished. A number of laws authorizing the formation of plank-road companies were passed, and a few legislatures authorized the grant of state aid to such undertakings. The movement was first commenced in or about 1846, but did not assume very extensive proportions before 1850. Soon after that year it was reported that a number of plank-road companies had been very successful in New York and Illinois, and that they had earned large dividends, amounting in a few cases to the entire cost of the road in a single year. A number of companies were organized in Pennsylvania and various other states.

But it did not require much experience to satisfy the public that this movement was in the wrong direction, not because improvements of the roads were undesirable, but because their condition deteriorated after the planks decayed, and the provisions for keeping them in repair were generally totally inadequate.

The street railways, on the other hand, being usually laid down on paved city streets, with iron tracks, and catering to the wants of increasing populations, were frequently attended with remarkable and enduring financial success, and although very few of such lines had been in existence in 1850, by 1860 their length and cost in leading cities were reported to be as follows:—

	Length, miles.	Cost.
Boston	67.39	$2,964,875
New York	61.79	5,002,835
Brooklyn	79.92	2,071,678
Hoboken	1.79	32,000
Cincinnati	17.38	403,163
St. Louis	26.30	576,590
Philadelphia	148.00	3,811,700
	402 57	$14,862,840

PRIMITIVE TRANSPORTATION MOVEMENTS WEST OF THE MISSOURI.

While railroads had gridironed a large portion of the country east of the Mississippi, and a few lines had been extended west of that river, a great wave of emigration was moving west of the Missouri to Kansas and Nebraska, Colorado, California, Oregon, and the travel and trade which grew out of this movement, and out of the Utah war, and the necessity of supplying frontier forts, was conducted chiefly by such primitive methods as had been followed a generation before by the pioneers who had sought homes in eastern portions of the Mississippi valley. The irksome nature of the protracted journeys over excessively long routes, and the time lost and sufferings endured by those who endeavored to reach the Pacific coast or Rocky mountain districts with ox teams, greatly heightened public interest in the

SURVEYS OF PROPOSED ROUTES FOR PACIFIC RAILWAYS,

which were duly described in official documents, discussed in Congress, and made part of the subject-matter of platforms of political parties. A presidential candidate was nominated in 1856 whose leading claim to distinction was that he had been one of the earliest pathfinders. Five leading routes were surveyed, at the expense of the Federal government, from the Mississippi or its tributaries to the Pacific, and modifications of four of these routes were also investigated. The cost of one near the thirty-eighth and thirty-ninth parallels was considered so great that it was pronounced impracticable. The estimated cost of the others ranged from $68,970,000, for the line proposed near the thirty-second parallel, from Fulton to San Pedro, 1,618 miles in length, to $169,210,265, for a route near the thirty-fifth parallel, from Fort Smith to San Francisco, 2,174 miles in length. The estimated cost of the route near the forty-first and forty-second parallels, via South Pass from Council Bluffs to Benicia, 2,032 miles in length, which approximately represents the route of the Union and Central Pacific, was $116,095,000. The estimated cost of the route near the forty-seventh and forty-ninth parallels, from St. Paul to Vancouver, 1,864 miles in length, was $130,781,000. It approximately represents the line of the Northern Pacific. Of the four routes considered practicable, the one nearest the southwestern boundary of the Republic, which corresponds with the Southern Pacific, was the shortest and cheapest, and about or shortly before 1860 it was the prevailing opinion that it would furnish the first railway route to California.

THE OVERLAND PONY EXPRESS.

Meanwhile telegraphic communication had not been established through the vast districts west of the Missouri, mail communication was frequently dilatory and uncertain, and the desire to secure the rapid dispatch of letters between such points as New York and San Francisco was becoming intense. This state of affairs, and propositions pending in Congress, led to a remarkable incident, typical of the spirit of the period, which was described by the St. Joseph (Missouri) News in the following extract from that journal:—

"In 1859 St. Joseph was the terminus of railroad communication. Beyond, the stage-coach, the saddle-horse, and the ox-trains were the only means of commerce and communication with the Rocky Mountains and the Pacific Slope. In the winter of 1860 there was a Wall street lobby at Washington trying to get $5,000,000 for carrying the mails overland one year between New York and San Francisco. The proposition was extremely cheeky, and William H. Russell, backed by Secretary of War Floyd, resolved to give the lobby a cold shower bath. He, therefore, offered to bet $200,000 that he could put on a mail line from Sacramento to St. Joseph that should make the distance—1,950 miles—in ten days. The bet was taken and the 8th of April fixed upon as the day of starting. Mr. Russell called upon his partner and general manager of the business upon the plains, Mr. A. B. Miller, now a citizen of Denver, and stated what he had done, and asked him if he could perform the feat. Miller replied: 'Yes, sir; I will do it, and do it by a pony express.' To accomplish this Mr. Miller purchased three hundred of the fleetest horses he could find in the west, and employed 125 men. Eighty of these men were to be post-riders. These he selected with reference to their light weight and their known daring courage. It was very essential that the horses should be loaded as light as possible; therefore, the lighter the man the better. It was necessary that some portions of the route should be run at the rate of twenty miles an hour. The horses were stationed from ten to twenty miles apart, and each rider would be required to ride sixty miles. For the change of animals and the shifting of the mails two minutes were allowed. Where there were no stage stations at proper distances, tents sufficient to hold one man and two horses were provided. Indians would sometimes give chase, but their cayuse ponies made but poor show in their stern chase after Miller's thoroughbreds, many of which could make a single mile in a minute and fifty seconds.

All arrangements being completed, a signal gun on the steamer at Sacramento proclaimed the meridian of April 8th, 1860—the hour for starting—when Border Ruffian, Mr. Miller's private saddle horse, with Billy Baker in the saddle, bounded away toward the foot hills of the Sierra Nevadas, and made his ride of twenty miles in forty-nine minutes. The snows were deep in the mountains, and one rider was lost for several hours in a snow storm; and after the Salt Lake valley was reached additional speed became necessary to reach St. Joseph on time. From here on all went well until the Platte was to be crossed at Julesburg. The river was up and running rapidly, but the rider plunged his horse into the flood, only, however, to mire in the quicksand and drown. The courier succeeded in reaching the shore, with his mail-bag in hand, and traveled ten miles on foot to reach the next relay. Johnny Fry, a popular rider of his day, was to make the finish. He had sixty miles to ride with six horses to do it. When the last courier arrived at the sixty-mile post, out from St. Joseph, he was one hour behind time. A heavy rain had set in, and the roads were slippery. Two hundred thousand dollars might turn upon a single minute. Fry had just three hours and thirty minutes in which to win. This was the finish of the longest race, for the largest stakes, ever run in America. When the time for his arrival was nearly up, at least five thousand people stood upon the river bank, with eyes turned toward the woods from which the horse and its rider should emerge into the open country in the rear of Elwood—one mile from the finish. Tick, tick, went the thousands of watches! The time was nearly up! But nearly seven minutes remained! Hark! a shout goes up from the assembled multitude. 'He comes! he comes!' The noble little mare, Sylph, the daughter of little Arthur, darts like an arrow from the bow and makes the run of the last mile in one minute and fifty seconds—landing upon the ferry-boat with five minutes and a fraction to spare."

IMPROVEMENT OF NATIONAL WATERWAYS.

THERE is a useful class of improvements, or aids to transportation, which has possessed varying degrees of importance at different periods, and which began to secure during or shortly before the sixth decade additional attention. They are works conducted under the authority and at the expense of the United States government for the purpose of facilitating the navigation of the numerous external and internal waterways of the country. The coast lines of the Atlantic, the Pacific, the lakes, and the gulf of Mexico, and the channels of tidal and non-tidal rivers, afford illimitable opportunities for wise and unwise, judicious and injudicious, outlays of public money, which have as their ultimate object or avowed purpose the diminution of the dangers to which water craft are exposed, the removal of obstructions, the deepening, concentration, or enlargement of channels, and the construction or improvement of harbors.

It would be impossible to assign limits to the sums that could be expended if the country persistently engaged in the performance, to the fullest extent, of all the tasks involved in such projects as have been proposed, and their logical counterparts, including the complete realization of this poetic conception:—

Bid the broad arch the dangerous flood contain,
The mole, projected, break the roaring main;
Back to his bounds the subject-sea command,
And roll obedient rivers through the land—
These honors Peace to happy nations brings;
These are imperial arts, and worthy kings.

In connection with such undertakings many complicated questions have arisen, relating to the extent to which it is right or expedient for the general government to undertake internal improvements of any kind or to improve rivers and harbors; and the manner in which appropriations should be distributed between multitudinous projects. Some administrations and statesmen have regarded certain classes of works as unconstitutional which other administrations and statesmen warmly approved. So much importance has been attached to these constitutional issues that they have at various periods exercised a controlling influence. The condition of the treasury has also affected, in a notable degree, the character and magnitude of the expenditures authorized at different times.

THE CONSTITUTIONAL QUESTIONS

began to atract attention some time after the first important works of internal improvement were undertaken by the Government, which was during Jefferson's administration, when Gallatin favored not only the construction of the national road, or turnpike, but various other roads and also appropriations intended to promote the construction of canals, such as the Chesapeake and Ohio and the canal which connects the Delaware with the Chesapeake. There were then special reasons for unusual efforts to improve internal communications which grew out of the fact that the first great field of development opened after partial recovery from the struggles and derangements caused by the protracted war of the Revolution, viz., opportunities for very extensive and profitable participation in the carrying trade of Europe, occasioned by the protracted wars in which her rival countries were engaged while the United States remained a neutral power,—were waning in magnitude, and the necessity for increasing attention to home development was strongly felt. Loss of great commercial advantages enjoyed during the Napoleonic wars threw this country back upon its own resources and steadily stimulated numerous and diverse movements originated in various quarters for the purpose of increasing the facilities for internal transportation.

In the progress of the discussion of the constitutional issues, four sets of theories have been promulgated, viz.:—

First. That the constitutional objections are of no practical moment, and should, therefore, be disregarded, in behalf of all meritorious works on land or water which possessed genuine national importance.

Second. That the constitutional objections could and should be avoided by an amendment of the constitution, which was the plan proposed by President Madison, who succeeded Jefferson, and who made the following reference to this subject in his annual message of December 5th, 1815:—

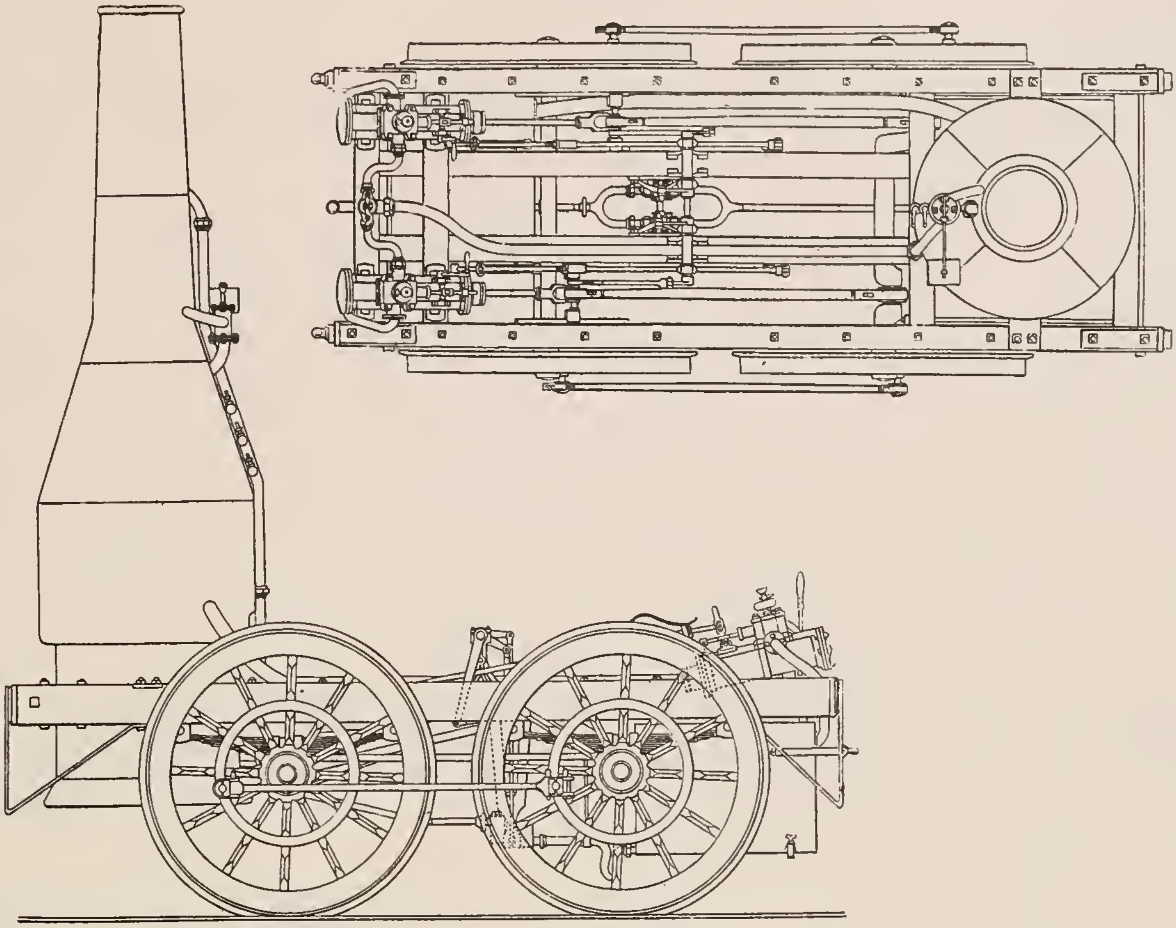
"Among the means of advancing the public interest, the occasion is a proper one for recalling the attention of Congress to the great importance of establishing throughout our country *the roads and canals which can best be executed under the national authority. No objects within the circle of political economy so richly repay the expense bestowed on them.* There are none, the utility of which is more universally ascertained and acknowledged; none that do more honor to the Government, whose wise and enlarged patriotism duly appreciates them. Nor is there any country which presents a field, where nature invites more the art of man, to complete her own work for their accommodation and benefit. The considerations are strengthened, moreover, by the political effect of these facilities for intercommunition, in bringing and binding more closely together the various parts of our extended confederacy.

Whilst the states, individually, with a laudable enterprise and emulation, avail themselves of their local advantages, by new roads, by navigable canals, and by improving the streams susceptible of navigation, the general government is the more urged to similar undertakings, requiring a national jurisdiction, and national means, by the prospect of thus systematically completing so inestimable a work. And it is a happy reflection *that any defect of constitutional authority which may be encountered can be supplied in a mode which the constitution itself has providently pointed out.*"

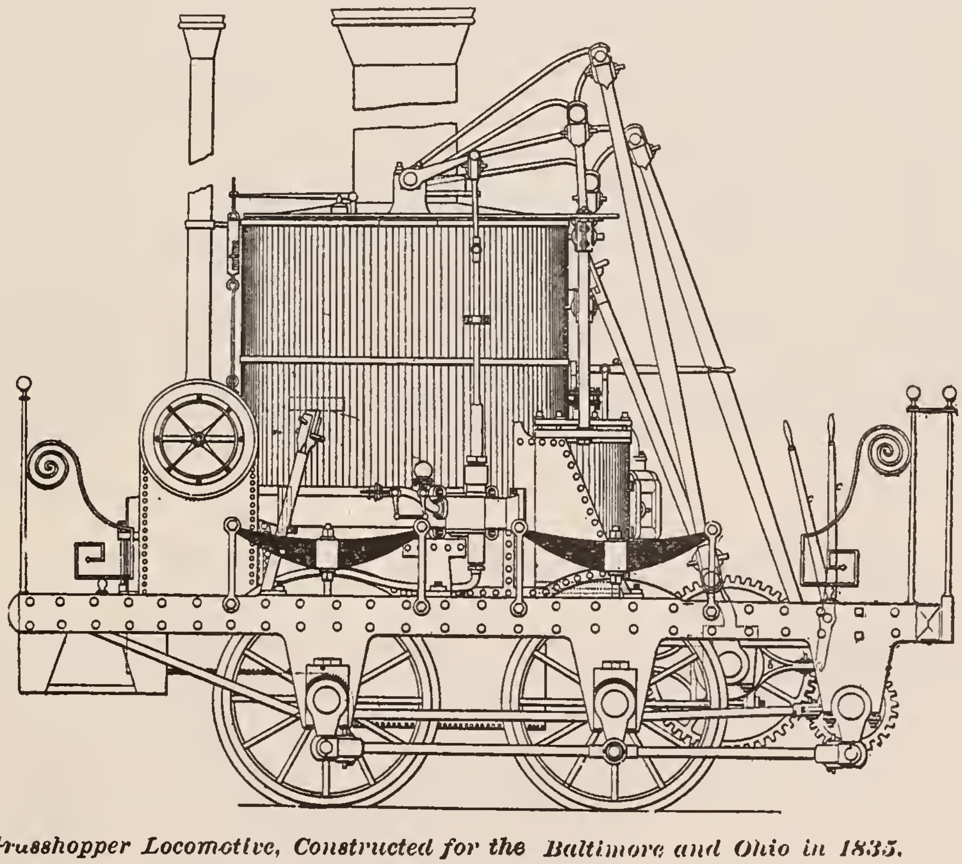
Third. That the constitutional restrictions were of controlling significance; and that the law-making powers should scrupulously respect them. This doctrine was strongly asserted in veto messages of several presidents, including Madison, Monroe, Jackson, and Pierce, but with special emphasis by General Jackson in exercising the veto power on sundry bills authorizing subscriptions to the stock of turnpike companies, appropriations for building light-houses, light-boats, beacons, monuments, placing buoys, and improving harbors and directing surveys, authorizing subscriptions to the stock of a company chartered to construct the Louisville and Portland Canal, and an act making an appropriation for improving the navigation of the Wabash river.

Fourth. That the most serious constitutional objections could be obviated by concert of action between the National or Federal government, and the respective states in which various works of conceded importance were located, such as placing the Cumberland or National road, for instance, under the control and direction of the various states it traversed; or making donations of public lands to Wisconsin for the improvement of the Fox and Mississippi rivers, or to Indiana for river or canal improvements, &c.

In actual practice, nearly all possible modifications of these doctrines, between the extreme limits of latitudinarianism and strict construction, have been applied to internal and coast improvements by different congresses and administrations, and during a lengthy period nearly all interior water improvements were made by the respective states, only a very limited amount of aid being granted by the general government.



Original Drawings of Best Friend, first American Locomotive built for Actual Service.



Grusshopper Locomotive, Constructed for the Baltimore and Ohio in 1835.

EARLY AMERICAN LOCOMOTIVES.

The real importance of the constitutional questions diminished after the

READINESS AND ABILITY OF PRIVATE CAPITAL

to construct the most necessary works became demonstrated. This view of the subject was forcibly illustrated in an address, delivered by Hon. Levi Woodbury in New York in 1849, in which he said:—

"I enter no debatable ground as to whose expense great internal improvements should be made, under the restrictions belonging to our political systems; nor whether much exists in such objections as I once heard in the senate to removing a sand-bar at the mouth of the Mississippi—the great Mediterranean sea of some eight or ten sovereign states—that it 'had been placed there by God and nature, and hence should remain;' nor to what particular localities they ought to be applied, except that they be those of national importance to foreign trade or to internal commerce among the states. But this question will be one of diminished magnitude hereafter, as the enterprise and capital of our country have at last attained such a giant growth *that where a prospect of remuneration exists, whether with or without public aid,* mountains will be tunneled or cloven down, valleys filled, rivers bridged, sand-bars removed, and harbors excavated. Already have the iron rail and steam horse pierced through the White Hills, though sustained only by private means; overcome, in like manner, the ridges of the Green mountains, and are fast approaching, nothing daunted, the Alleghenies, and seek a passage through the gorges of the Rocky mountains, even to the Pacific, without fear or faint-heartedness, if but backed by grants of the public domain, which, thus applied, under proper guards, are certainly in the end most likely to enrich the donor most."

Conflicting influences have resulted in the adoption of

A SEE-SAW POLICY,

involving unnecessary or useless expenditures for particular purposes at some periods, and a refusal or neglect to make any provision whatever for works of great importance at other times. This tendency to rush from one extreme to another, and to spend either too much or too little money for almost any given object, in any particular year, has been materially increased by the adoption of a system of making the Government outlays gratuitous in nearly all cases, so that instead of being governed by business principles and constructing improvements of the kind that would probably be of sufficient importance to yield a revenue proportionate to the interest of their cost, this element or consideration has been almost wholly ignored, and it depends upon favor, or temporary influence, whether a particular project will or will not receive any aid whatever, in any special year, and it is always to some extent uncertain how much will be appropriated at any session of Congress for the continuance of any work.

The United States adopted at the outset, in the first task assumed in connection with the protection of nautical operations, which was the construction and maintenance of light-houses, a course different from that pursued by most other civilized governments, inasmuch as it was the general custom elsewhere to impose on vessels light-house charges corresponding with the sums spent for maintaining them, while in this country similar exactions have not been made. In some respects, and at many periods, this exemption has been beneficial to all concerned, but it has probably led, at other periods, to a perilous neglect or postponement of useful works; and the extension of the principle of treating nearly all national improvements of waterways, and safeguards of navigation, as governmental bounties which were not to be paid for by those specially benefited by their use, to almost every class of oceanic, river, and harbor improvements, has probably given rise to much of the uncertainty in regard to the amount and character of the work performed at various periods.

In all fundamental discussions of questions relating to the nature of the authority or organization that should provide the means for expensive improvements of the routes over which persons and property can be or are to be moved, one of the most important of the vital issues involved, is whether the burden of the contemplated outlay is to be partly borne by the particular persons and interests benefited, or wholly by an entire community, state, or nation; and in a general sense, it may be assumed that this question has practically been decided in this country in favor of the exemption of water carriers from charges based on national expenditures which are intended to improve the channels they use, while traffic moved over land routes is generally expected to pay a proportionate share of the cost of the improvements of the roads over which it is moved, either indirectly, through local taxation, or directly, in additions to the freight bills of railway companies.

So far as the primitive condition of water channels is concerned, this advantage of water carriers is entirely legitimate or a bounty of nature that is freely placed at their disposal, without money and without price. Formerly it conferred an absolute or overwhelming superiority upon localities and interests endowed with excellent watercourses, or convenient access to them, over all localities and interests that were obliged to depend exclusively upon overland methods of transportation, but this superiority or advantage has been neutralized, to a very great extent, by enormous reductions in the cost of land movements, and it may eventually become a serious question how far due regard for the welfare of the entire body of the American people, including many millions who reside at points remote from excellent water channels, is consistent with some of the actual and proposed national expenditures for river, harbor, and canal projects which are not expected to yield any direct return or revenue.

Under the system now in force, the general government may do any conceivable thing, or nothing, in behalf of the transportation interests of districts located near navigable waters, while little or nothing in the way of aid or appropriations from Congress can be expected by districts that are obliged to depend exclusively upon land routes.

The matters thus briefly referred to gain importance from the wonderful extent of the actual and possible exterior and interior water channels with which this country has been magnificently endowed, the numerous competitive struggles between land and water carriers, and the great differences in the degree in which various communities are directly benefited by such appropriations for the improvement of waterways as are usually made.

LIGHT-HOUSES, LIGHT-SHIPS, AND BUOYS.

ONE of the first subjects over which the general government assumed control to the exclusion of state authority, about or before the time of the adoption of the Federal constitution, with the free consent of the states, was the maintenance of light-houses along the Atlantic coast. Originally they were few in number. The first light-house built in the present limits of the United States was erected at Little Brewster Island, in Boston harbor, in 1715–16, at a cost of £2,385 17s. 8d., at the expense of the General Court of the Province of Massachusetts. It was maintained by the exaction of a penny per ton on all incoming and outgoing vessels except coasters. This practice of exacting from the vessels benefited by the light-houses the cost of maintaining them has been general among European nations, although of late years there are a few exceptions, while the United States government has rendered all its light-house service gratuitously. In addition to the light-house near Boston it is known that the ports of Portland, Portsmouth, Newburyport, Cape Ann, Plymouth, Nantucket, Newport, New London, New York, the capes of the Delaware, the capes of the Chesapeake, the port of Charleston, and the mouth of the Savannah river were all lighted previous to 1789. Since that period great additions have been made in the number of light-houses, and in the list of other classes of available danger signals, such as buoys, beacons, and light vessels. Originally such works were located exclusively on the Atlantic coast, which, on account of its importance as a channel for nearly all extensive freight movements between the original states, and between this country and foreign nations, imperatively needed all the aid of the kind furnished, and received much less attention than was desirable. After the acquisition of Louisiana and Florida, the commencement of extensive shipments on the lakes, the acquisition of California and establishment of settlements on the Pacific coast, and the improvement of numerous rivers and harbors, the field of light-house operations expanded to an enormous extent. Up to a period near the close of the sixth decade the total national expenditures for such purposes had been about $10,000,000, or at the average rate per annum of less than $150,000, while shortly before 1860 the annual expenditures were nearly $1,000,000. On June 30th, 1859, there were 491 light stations on the oceanic, lake, and gulf coasts, and on the shores of various bays, sounds, and rivers, and between 5,000 and 6,000 buoys and beacons. Subsequently the number of lights was greatly increased, especially on the shores of interior navigable rivers, and there has been a corresponding increase in the outlays for such purposes. A very useful life-saving service has also been established along the seacoasts. The right and duty of the general government to provide such aids to commerce has rarely been seriously questioned, and an immense amount of useful service has been rendered by them to water craft engaged in domestic and foreign trade.

EXPANSION OF THE LIGHT-HOUSE SYSTEM.

The extraordinary extent to which the light-house system has expanded since 1860 is shown by the annual reports of the light-house board, made to the Secretary of the Treasury. The report for the fiscal year ended June 30th, 1885, embraces an estimate of $2,144,000 for general appropriations, and $1,346,250 for special appropriations, and it states that at the close of the year there were under the control of the light-house establishment the following-named aids to navigation:—

Light-houses and lighted beacons, including stake lights, in Third, Sixth, and Eighth Light-house districts	864
Light-ships in position	22
Light-ships for relief	7
Lighted buoys in position	4
Fog signals operated by steam or hot air	71
Fog signals operated by clock-work	131
Beacon lights on the western rivers	1,061
Day or unlighted beacons	314
Whistling buoys in position	35
Bell buoys in position	35
Other buoys in position, including 178 pile buoys and stakes in Fifth district, and 14 buoys in Alaskan waters	3,712

In the construction, care, and maintenance of these aids to navigation there were employed:—

Steam tenders	24
Steam launches	3
Sailing tenders	2
Light keepers, including laborers in charge of western river lights	1,927
Other employés, including crews of light-ships and tenders	663

During that year there had been an increase of 101 lighted aids and 207 unlighted aids to navigation, making the number of the former 1,951, and of the latter 4,284, a total of 6,235. They were distributed among fifteen districts, into which all portions of the oceanic, lake, gulf, and river regions to which light-house or analogous aids to navigation had been furnished are divided. In addition to the general supervision of the light-house board, each of these districts is in special charge of an inspector, who is an officer of the United States navy, and an engineer, who belongs to the engineer corps of the United States army.

The number of the aids to navigation of each class which were furnished in 1885 on the various coasts and rivers is shown by the following table:—

Aids.	Atlantic and gulf coasts.	Pacific coast.	Lake coast.	Rivers.	Total for entire coast, 1885.
Electric lights	1	....	....	....	1
First-order lights	39	12	....	....	51
Second-order lights	16	1	3	....	20
Third-order lights	26	4	21	....	51
Three-and-a-half-order lights	3	...	8	....	11
Fourth-order lights	139	16	69	....	224
Fifth-order lights	98	4	31	....	133
Sixth-order lights	68	....	58	....	126
Lens lanterns	25	24	4	....	53
Range lenses	17	....	....	....	17
River lights	130	....	9	1,061	1,200
Reflectors	34	....	4	....	38
Light-ships in position	22	....	....	....	22
Lighted buoys	4	....	....	....	4
Total lighted aids	622	61	207	1,061	1,951
Fog signals operated by steam or hot air	34	16	21	....	71
Fog signals operated by clock-work	114	5	12	....	131
Day beacons	270	43	1	....	314
Whistling buoys	27	8	....	....	35
Bell buoys	34	....	1	....	35
Other buoys	3,190	161	347	....	3,698
Total unlighted aids	3,669	233	382	....	4,284
Total aids to navigation	4,290	294	589	1,061	6,235

THE LOCATION OF THE DISTRICTS

and number of aids in each in 1885 are shown by the following statements:—

The first district extends from the north-eastern boundary of the United States, Maine, to and including Hampton harbor, New Hampshire, and includes all the aids to navigation on the coasts of Maine and New Hampshire. In this district there are—

Light-houses and lighted beacons	54
Day or unlighted beacons	93
Fog signals operated by steam or hot-air engines	10
Fog signals operated by clock work	8
Whistling buoys in position	7
Bell buoys in position	10
Other buoys in position	481
Steamer Iris, buoy tender and for supply and inspection	1
Steamer Myrtle, used for construction and repair in the first and second districts	1

The second district extends from Hampton harbor, New Hampshire, to Gooseberry Point (entrance to Buzzard's bay), Massachusetts, embraces all the aids to navigation on the coast of Massachusetts. In this district there are—

Light-houses and lighted beacons	63
Light-ships in position	8
Light-ships for relief	2
Day or unlighted beacons	53
Fog signals operated by steam or hot-air engines	7
Fog signals operated by clock work	8
Bell boat in position	1
Whistling buoys in position	6
Bell buoys in position	5
Other buoys in position	455
Ice buoys for winter use	3
Steamers Verbena and Putnam, buoy tenders and for supply and inspection	2
Steamer Myrtle, used for construction and repair in the first and second districts	1

The third district extends from Gooseberry Point, Massachusetts, to include Squan Inlet, New Jersey, and embraces all the aids to navigation on the sea and sound coasts of Rhode Island, Connecticut, and New York, Narragansett and New York bays, Providence and Hudson rivers, Whitehall Narrows, and lakes Champlain and Memphremagog. In this district there are—

Light-house and lighted beacons	156
Light-ships in position	5
Light-ships for relief	3
Lighted buoy	1
Day or unlighted beacons	41
Fog signals operated by steam or hot-air engines	11
Fog bells operated by clock work	31
Whistling buoys in position	3
Bell buoys in position	4
Other buoys in position	514
Steamers John Rodgers and Cactus, buoy tenders and for supply and inspection	2

Steamer Fern, used for supplying with illuminating and cleansing materials the light stations of the Atlantic and gulf coasts....... 1
Steamers Mistletoe and Grace Darling, used for works of construction and repair of light houses, fog signals, &c.................. 2

The fourth district extends from Squan Inlet, New Jersey, to and including Metomkin Inlet, Virginia. It includes the seacoasts of New Jersey below the Highlands of Navesink, the bay-coasts of New Jersey and Delaware, navigable route of the Delaware and Schuylkill rivers, seacoasts of Delaware and Maryland, and part of the seacoast of Virginia. In this district there are—

Light-houses and lighted beacons	46
Light-ships in position	4
Light-ship for relief	1
Day or unlighted beacon	1
Fog signals operated by steam or hot-air engines	3
Fog signals operated by clock work	7
Whistling buoys in position	3
Bell buoys in position	2
Iron ice buoys in position	3
Other buoys in position	158
Steamer Geranium, buoy tender and for supply and inspection	1

The fifth district extends from Metomkin Inlet, Virginia, to include New River Inlet, North Carolina, and embraces part of the seacoast of Virginia and North Carolina, Chesapeake bay, the sounds of North Carolina, and the James and Potomac rivers. In this district there are—

Light-houses and lighted beacons	93
Day or unlighted beacons	12
Fog signal operated by steam engine	1
Fog signals operated by clock work	53
Lighted buoys in position	2
Whistling buoy in position	1
Bell buoys in position	2
Other buoys in position, including pile buoys and stakes	1,036
Steamer Jessamine, used in construction and repair	1
Steam-launch Nettle, used in construction and repair	1
Steamers Holly and Violet, buoy tenders and for supply and inspection	2
Steam-launch Bramble, used to supply gas to the beacons in the sounds of North Carolina	1

The sixth district extends from New River Inlet, North Carolina, to and including Cape Canaveral, Florida, and includes all the aids to navigation within these limits on the coasts of North Carolina, South Carolina, Georgia, and Florida. In this district there are—

Light-houses and lighted beacons	110
Light-ships in position	3
Light-ships for relief	1
Lighted buoys in position	1
Day or unlighted beacons	22
Fog bells operated by machinery	2
Whistling buoys in position	4
Bell buoys in position	11
Other buoys in position	258
Steamer Wistaria, buoy tender and used for inspection and supply	1
Schooner Pharos, used for construction and repair	1

The seventh district extends from just south of Cape Canaveral, Florida, to the mouth of the Perdido river, Florida, and includes all the aids to navigation on the Atlantic and gulf coasts of Florida within these limits. There are in this district—

Light-houses and lighted beacons	19
Day or unlighted beacons	40
Whistling buoys in position	1
Other buoys in position	201
Steamer Laurel, buoy tender and for supply and inspection	1
Steamer Arbutus, used for construction and repairs in the seventh and eighth districts	1
Schooner Mignonette, used for construction and repairs in the seventh and eighth districts	1

The eighth district extends from the mouth of the Perdido river, Florida, to the mouth of the Rio Grande, the southern boundary of Texas, and includes all the aids to navigation on the gulf coast within the above limits, and the Mississippi sound, lake Pontchartrain, lake Maurepas, and the Mississippi river below New Orleans. In this district there are—

Light-houses and lighted beacons (including six stake lights on the Mississippi river)	55
Light-ships in position	2
Day or unlighted beacons	8
Fog signals operated by steam or hot-air engines	2
Fog signals operated by clock work	5
Whistling buoys in position	2
Other buoys in position	84
Steamer Pansy, buoy tender and for supply and inspection	1
Steamer Arbutus, for construction and repairs in the seventh and eighth districts	1
Schooner Mignonette, for construction and repairs in the seventh and eighth districts	1

[No report of the ninth district was made in 1885, but the creation of a new district was recommended.]

The tenth district extends from the mouth of St. Regis river, New York, to and including Grassy Island, Detroit river, Michigan, and embraces all the aids to navigation on the American shores of the St. Lawrence river, lake Ontario, lake Erie, and the Detroit river, within those limits. In this district there are—

Light-houses and lighted beacons	67
Fog signals operated by clock work	5
Buoys in position	164
Steamer Haze, buoy tender and for supply and inspection	1

The eleventh district embraces all aids to navigation on the northern and north-western lakes above Grassy Island Light station, Detroit river, and includes lakes St. Clair, Huron, Michigan, and Superior, and the straits connecting them. In this district there are—

Light-houses and lighted beacons	140
Day or unlighted beacons	1
Fog signals operated by steam	21
Fog signals operated by clock work	7
Bell buoy in position	1
Other buoys in position	183
Steamer Dahlia, buoy tender and for supply and inspection	1
Steam barge Warrington, used for construction and repair	1

The twelfth district extends from the boundary line between California and Mexico to the boundary line between California and Oregon, and embraces all the aids to navigation on the coasts and bays of California. In this district there are—

Light houses and lighted beacons	22
Day or unlighted beacons	29
Fog signals operated by steam or hot-air engines	12
Fog signals operated by clock work	3
Whistling buoys in position	6
Buoys in position	34
Steamer Manzanita, buoy tender and for supply and inspection	1

The thirteenth district extends from the southern boundary of Oregon to the boundary between the United States and British Columbia, and embraces all aids to navigation on the Pacific coast of Oregon and Washington Territory, and in the Columbia and Willamette rivers, straits of Fuca and Puget sound. There are in the district—

Light-houses and lighted beacons	39
Day or unlighted beacons	14
Fog signals operated by steam	4
Fog signals operated by clock work	2
Whistling buoys in position	2
Other buoys in position	127
Steamer Shubrick, buoy tender and for supply and inspection	1

The fourteenth district extends from Pittsburgh, Pa., to Cairo, Ill., a distance of 964 miles, and embraces all the aids to navigation on the Ohio river. In this district there are—

Fixed beacon lights	416
Floating beacon lights	22
Steamer Lily, for supply and inspection	1

The fifteenth district extends on the Mississippi river from the head of navigation to New Orleans, on the Missouri to Kansas City, and on the Red river a distance of 8 miles, being, in all, a distance of over 2,500 miles, and embraces all the aids to navigation within these limits. In this district there are—

Beacon lights	623
Steamer Joseph Henry, for supply and inspection	1
Steam launch Ivy, for supply and inspection	1

It will be seen from the above statements that the operations of the light-house system not only include a variety of appliances for aiding navigation on all national oceanic, gulf, and lake coasts, but also many river lights, the number of the latter in 1885 being 1,200, and the rivers illuminated including the

Hudson, Delaware, James, Potomac, Ohio, Detroit, Mississippi, Missouri, and Columbia.

The aids furnished are necessarily, to some extent, in a transition state, as they are liable to decay or various injuries, but with a marked tendency to a notable improvement at nearly all points, at all periods, either in their number or character, or both respects, and as new methods of lighting have been devised they have usually been promptly adopted.

LIGHT-HOUSES AND LIGHTING APPARATUS.

THE first great task presented was the construction of light-houses, some of which are in localities that rendered their erection peculiarly difficult. At first a style of architecture resembling that of the first light-house in the country was closely adhered to, consisting of a solid stone edifice circular or tapering, with the smallest diameter possible for the construction of a spiral staircase and just enough space on the top to provide room for such lights as were necessary. But during later years various deviations from the old style were authorized, some of which consist of the erection of light-houses of a class best described by their title of iron skeleton tower light-houses.

An article on light-house engineering, as displayed at the Centennial Exhibition, written by J. G. Barnard, of the United States army, and published in the Transactions of the American Society of Civil Engineers, states that the light-house on Minot's Ledge, a body of rocks at the entrance to Boston harbor was, at that date, "the most important engineering work that belongs to our light-house system, and indeed it ranks, by the engineering difficulties surmounted in its erection, and by the skill and science shown in the details of its construction, among the chief of the great sea-rock light-houses of the world." On account of these difficulties, he states that "the structure was made solid (around a central wall) up to the level of the entrance door. Above that there is a hollow, cylindrical space, fourteen feet in diameter, arched over at the level of the cornice. This space is divided into five stories by four iron floors. These five compartments, and a sixth, immediately under the lantern, constitute the keeper's rooms, store rooms, &c." Work on this structure was commenced in 1855, and several years were required for its completion.

Another class of light-houses, of which more than fifty had been constructed before 1876, are known as screw-pile light-houses, from the manner in which a foundation is secured in sand shoals, or other formations in which peculiar difficulties exist. The first structure of this class was erected in 1847–50 at Brandywine shoal, near the mouth of Delaware bay.

In other instances foundations are secured by ordinary methods of pile driving, or by excavations of rocks.

The height of light-houses varies greatly with the requirements of different localities, and in the cases where an elevation of at least 150 feet is necessary, special efforts must be made to obtain a secure foundation, and all other elements of stability and well-devised interior arrangements.

Other light-houses rise only a comparatively small distance above the surface of the surrounding or adjacent waters. One of this class, on which a fog whistle operated by steam is used, in addition to the display of lights, was completed in 1885. It is located at the west end of lake Erie, at the mouth of the Detroit river. The foundation pier is composed of a crib built with 12×12-inch timbers, with solid bottom of same-sized timber, both sides and bottom being calked, the whole filled with concrete to within 4 feet of lake level, the cut-stone masonry facing, backed with concrete, rising 11 feet above the same level.

The tower is located on the south end, and is the frustrum of a cone 32 feet high, forming 4 stories, surmounted by a main gallery deck, a cylindrical watch room 10 feet in diameter and 8 feet high. The lantern is ten-sided, and of the fourth order, of the standard pattern. The fog-signal house is located on the north end of the pier. The fog signals are in duplicate, consisting of a 10-inch whistle, a 30-horse power locomotive boiler, a 4×9-inch vertical engine, whistle gear, whistle valve, force pump, and inspirator. There is also a boiler-iron water tank of 50 cubic feet capacity, sufficient to fill one boiler with water.

In connection with the lighting of rivers a class of lights peculiar to the United States, known as stake lights, and which are used extensively on the Mississippi, Missouri, and Ohio was adopted. They were substituted in lieu of permanent structures, on account of the variability of the channels of these rivers. They consist of a large lantern or locomotive head-light suspended from a post or wooden scaffolding easily removable, and generally called a stake, on the banks, the position of which may be shifted to correspond to the shifting of the channels.

IN THE LIGHTING APPARATUS

used in the light-houses of various grades remarkable progress has been made. With the increase of the number of light-houses along the coasts the objects to which they were applied extended from indications of the entrances of important rivers and harbors to an illumination of the entire coast; and it became necessary that means should be devised for enabling mariners who were approaching American shores to distinguish between the different light-houses. For this purpose, as well as to increase the aquatic area that can be illuminated, when necessary, a variety of ingenious devices have been invented and applied. The methods of creating distinguishing features include the following:—

(1.) By grouping; that is, by building two lights in close proximity to each other, so far apart that at any distance they will appear separated; and sufficiently close, that they will always be recognized as belonging to each other.

(2.) By means of colors (red, blue, and green light.)

(3.) By means of giving the light a varying intensity, in such a way, that within a certain period of time it decreases from greatest brilliancy to entire darkness, and then again increases to greatest brilliancy.

This latter method is the one most frequently employed.

Various illuminating fluids have also been used at various periods and places, but mineral oil has of late years been generally used, although an electric light was successfully introduced in Hell Gate channel, near the city of New York. The varieties of lights produced in the stationary light-houses of the United States are chiefly the following: 1, fixed white; 2, fixed red; 3, flashing white; 4 flashing red; 5, flashing white and red; 6, fixed white, varied by white flashes; 7 fixed white, varied by red flashes; 8, fixed white, varied by red and white flashes; 9, flashing red and white. These forms are further diversified by variations in periods of intensity or other methods. Aside from the use of glass of various colors, and lamps of great illuminating power, the desired effects are produced by scientific combinations of reflectors or refracting apparatus, worked by clock-work.

Independent of the aids to navigation furnished by lights, there are a number of fog signals operated by steam, hot air, or clock-work; a considerable number of day beacons, some of which consist of wrought-iron shafts painted in colors that will attract attention, and a large number of buoys classified as whistling buoys, bell buoys, and other buoys.

THE COAST SURVEY.

THE characteristic uncertainty of governmental operations relating to transportation requirements is illustrated by the protracted postponement of efficient measures for surveying the extensive coasts of this country, and detecting their hidden dangers during one period, and large outlays of questionable utility at other periods. It now seems almost incredible that the first attempt to organize a national coast survey was made in 1807, and that despite a considerable amount of discussion and preliminary efforts, intermingled with a few actual labors, a quarter of a century elapsed before a coast-survey system was finally established at first under the direction of F. R. Hassler. Still more time was required to secure the establishment of a comprehensive mode of procedure, which began with the appointment of Prof. A. D. Bache, in 1843. Under his direction extensive operations were skillfully and economically conducted for nearly an additional quarter of a century. An immense amount of useful work was performed under the direction of his successors, but comparatively recent operations of coast-survey superintendents have been severely criticized, partly on the ground of inefficient or careless management.

An abstract of a report presented to Congress in May, 1886, by a committee of which representative Herbert, of Alabama, was chairman, says that "in regard to the coast and geodetic survey, the report refers to the fact that after an expenditure of over $24,000,000 and an existence of more than three-quarters of a century it has not even completed the first survey of our coast line. The loose and corrupt management which was discovered by the investigation under direction of the Secretary of the Treasury last summer is allnded to and many of the incidents of extravagance specified. The report then shows that the bureau has sought scientific methods instead of practical results, has made slow progress, has indulged in unnecessary and expensive topography which cost about $250 per square mile, and that the dangers of the sea have been neglected.

It is recommended that the coast survey should be under the Navy Department for various reasons, chiefly because such surveys are under the conduct exclusively of the marine ministries in Great Britain, France, Germany, Italy, Austria, Japan, Sweden, Holland, Chili, British India, Portugal, Denmark, Spain, Russia, Belgium, Norway, and Java (East Indies.) In fact, it is believed that in no country except the United States can such a survey be found conducted in other departments."

A controversy had arisen, partly from a desire to secure a transfer of the direction of coast-survey operations from the Treasury Department to the Navy Department, and partly from a feeling among officials connected with the geological survey, that there had been undue interference with its operations. The nature of the issues raised, and character of the complaints made, are indicated by the following article from the Boston Journal, on

THE METHODS OF THE COAST SURVEY.

"Lieutenant George I. Dyer's paper on 'The Survey of the Coast,' reprinted from the proceedings of the United States Naval Institute, makes a strong presentation of arguments for transferring the work of the coast survey from the Treasury to the Navy Department, and for carrying on the work with a closer regard to the needs of navigators. In every other country save our own this work devolves, as a matter of course, upon naval officers. From 1834 to 1836 it was conducted by the Navy Department, but since the latter date has formed a part of the Treasury Department, constituting practically an independent bureau. Several things have resulted. The work done has been very costly; it has been needlessly minute; it has had about as much to do with topography as with hydrography, and that part of the work which really pertains to the coasts, and which is necessary to the safety of mariners, has been delayed by the pressure of work of a different sort, which, whatever its scientific value or interest may be, is foreign to the original purpose of the survey. The present title, Coast and Geodetic Survey, was not legalized until 1879, although an act was passed in March, 1871, which legalized the determination of geodetic points in each state of the Union and across the continent. Assistant Baker, of the survey, testifies that 'since the creation of the survey by the act of 1807, the field of the survey's operations has been gradually extended, until it now by law embraces the entire United States and the waters off the coast to a limit incapable of sharp definition.' The result of this large extension of the field is that the coast of the United States is not yet surveyed, and there are portions of it where any vessel venturing is subject to risks which, at this time, nearly eighty years from the commencement of the work, place a high degree of culpability on this organization. On this point Commander Bartlett says: 'The triangulation carried on by this organization has been of the most refined and expensive character. The topography has been executed with the utmost elaboration. The character of its work, from a scientific standpoint, cannot be assailed. But in the meantime the 'survey of the coast' has dragged along, and no time is yet set for its definite completion.

For the reason, then, that the accomplishment of its principal object was being delayed—indirectly, perhaps—this organization assumed a grave responsibility in not changing its methods long ago.

From the standpoint of the sailor, who has to venture into unknown waters, how can the expenditure, by this organization, of millions of money for purposes more or less foreign to a coast survey be justified?'"

DIFFICULT NATURE OF SOME OF THE LIGHT-HOUSE AND COAST-SURVEY OPERATIONS.

A considerable proportion of the labors performed in connection with the construction and maintenance of light-houses, and the coast survey, required a large amount of scientific knowledge, and in the prosecution of the extensive works by which additional protection has been furnished to the coasts, channels, and harbors of this country a number of important improvements were, from time to time, devised which reflect great credit on their originators. The general fact that all classes of modern transportation movements are largely based upon the application of scientific principles to the prosaic but vitally important work of moving persons and property usually receives less recognition than it deserves, and there are few fields in which a higher range of intellectual effort has been required than those directly connected with the protection of the cargoes and seamen that traverse the vast distances embraced within water channels of the United States. If erroneous methods have sometimes been adopted, they are probably due, in a great measure, to the inherent defects of governmental efforts to perform complicated tasks, which are not subjected to the contemporaneous criticism of parties who are obliged to defray a material portion of the expenses incurred. It is possible that the lavish bounty of the nation, in such matters, may be carried to an extent that finally thwarts the original objects, and something like this must have occurred if the assertion is well founded that an expenditure of $24,000,000 for a coast survey has not been found sufficient to secure a reliable survey of the coast, despite the unquestionable ability of a large proportion of the men who were entrusted with the performance of that task.

RAILWAY CONSTRUCTION FROM 1860 TO 1869.

FOR the first time in the history of American construction, one decade witnessed a smaller amount of additions to mileage than its predecessor, the gross amount being 16,090.36 miles during the ten years ended with the close of 1869, against 20,109.63 during the ten years ended with 1859, the civil war, for a time, leading to a total cessation of new construction in many portions of the country. The new mileage of the seventh decade, in each group, each year, was as follows:—

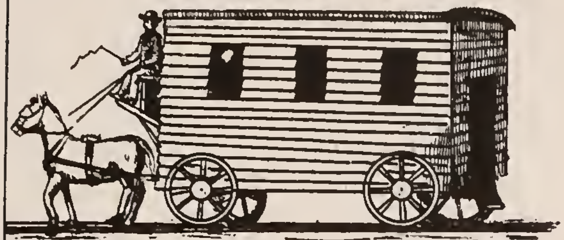
	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	Decade.
Total United States	1,497.72	1,015.85	720.00	573.90	974.40	8t8.72	1,403.58	2,540.68	2,467.86	4,102.65	16,090.36
I. Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut	5.79	61.21	3.97	15.70	33.74	39.04	56.93	81.42	84.49	93.87	476 16
II. New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, and District of Columbia.	242.18	113.23	399.90	440.40	406.25	372.13	543.61	724.75	513.66	1,108.76	4,865.05
III. Virginia, West Virginia, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, and South Carolina	777.81	578.05	132.00	27.10	24.56	10.75	26.50	452.10	336.44	511.43	2,876 74
IV. Illinois, Iowa, Wisconsin, Missouri, and Minnesota	246.77	161.51	184.13	56.30	331.70	278.95	326.82	768.54	579.93	1,475 57	4,410.22
V. Louisiana, Arkansas, and Indian Territory	103.00	61.60	....	....	....	....	19.40	....	....	....	184.00
VI. Dakota, Nebraska, Kansas, Texas, New Mexico, Colorado, Wyoming, Montana, Idaho, Utah, Arizona, California, Nevada, Oregon, and Washington	124.17	40.25	....	34.40	151.15	117.67	430.32	513.87	953.34	913.02	3.278.19

The names of the companies reporting this new mileage in 1880 were as follows:—

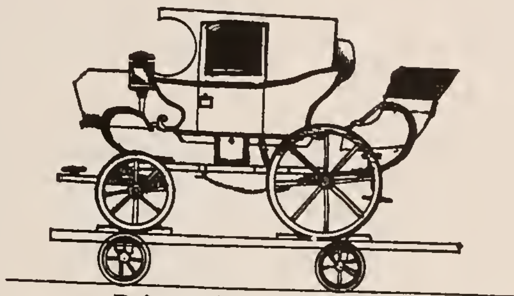
GROUP I. THE NEW ENGLAND STATES.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	Decade.
Bangor and Piscataquis	....	....	....	....	....	....	....	....	....	40.00	40.00
Boston, Clinton, Fitchburg and New Bedford	....	....	....	....	....	....	13.97	....	....	....	13.97
Boston and Lowell	....	....	2.37	....	....	....	....	....	....	....	2.37
Concord	....	2.00	....	....	....	....	....	....	....	....	2.00
Concord and Portsmouth	....	11.46	....	....	....	....	....	....	....	....	11.46
Connecticut and Passumpsic Rivers	....	....	....	....	15 00	....	....	5.00	....	....	20.00
Dexter and Newport	....	....	....	....	....	....	....	....	14 00	....	14.00
Eastern (of Massachusetts)	....	4.00	....	....	....	....	....	....	....	....	4.00
European and North American	....	....	....	....	....	....	....	....	26.71	31 29	58.00
Fall River, Warren and Providence	5.79	....	....	....	....	....	....	....	....	....	5.79
Hanover Branch	....	....	....	....	....	....	....	....	7.78	....	7.78
Housatonic	....	....	....	....	....	....	....	....	....	3.00	3.00
Maine Central	....	31.00	....	....	....	3.00	....	....	....	....	34.00
Milford and Woonsocket	....	....	....	....	....	....	....	....	3.88	....	3.88
New Canaan	....	....	....	....	....	....	....	....	8.30	....	8.30
New Haven and Northampton	....	....	....	....	....	....	....	....	7.49	....	7.49
New London and Northern	....	....	....	....	....	....	. ..	14 96	....	....	14.96
New York and New England	....	12.75	1.60	10.90	....	....	9 40	20.70	....	....	55.35
New York, New Haven and Hartford	....	....	....	....	....	3.20	....	....	....	....	3.20
Old Colony	....	....	....	....	18.74	18.84	33.56	....	....	....	71.14
Portland and Oxford Central	....	....	....	....	....	....	....	27.50	....	....	27.50
Portland and Rochester	....	....	....	....	....	14.00	....	....	....	....	14.00
Rockville	....	....	....	4.80	....	....	....	....	....	....	4.80
South Manchester	....	....	....	....	....	....	....	....	....	2.25	2.25
Suncook Valley	....	....	....	....	....	....	....	....	....	17.33	17.33
Troy and Greenfield and Hoosac Tunnel	....	....	....	....	....	....	....	13 26	16.33	....	29.59
GROUP II. NEW YORK, PENNSYLVANIA, OHIO, MICHIGAN, INDIANA, MARYLAND, DELAWARE, NEW JERSEY, DISTRICT OF COLUMBIA.											
Adirondack	....	....	....	....	....	25 00	....	....	12.00	12.00	49.00
Albany and Susquehanna	....	....	3.00	32.00	10.00	37.00	21.00	17.00	....	22.11	142.11
Allegheny Valley	....	....	....	....	....	....	10.00	14.00	....	....	24.00
Bald Eagle Valley	....	....	....	53.87	....	....	....	....	....	....	53.87
Belvidere-Delaware	....	....	....	....	3.24	....	....	....	....	....	3.24
Brookfield Coal	....	....	2.09	....	....	....	....	....	....	....	2.09
Brooklyn, Bath and Coney Island	....	....	....	7.25	....	....	....	....	....	....	7.25
Brooklyn and Montauk	....	....	....	....	....	....	....	....	51.58	....	51.58
Brooklyn and Rockaway Beach	....	....	....	....	....	3.50	....	....	....	....	3.50
Buffalo, Bradford and Pittsburgh	....	....	....	....	....	....	25.97	....	....	....	25.97
Buffalo, New York and Philadelphia	....	....	....	....	....	....	....	16.69	....	....	16.69
Camden and Burlington County	....	....	....	....	....	....	....	29.61	....	....	29.61
Catasauqua and Fogelsville	....	....	....	....	8.00	....	2.00	....	2.00	....	12.00
Catawissa	....	....	....	....	2 48	....	....	....	....	....	2.48
Central of New Jersey	....	....	....	....	11.50	....	....	....	....	6.20	17.70
Chester	....	....	....	....	....	....	....	10.00	....	....	10.00
Chester Creek	....	....	....	....	....	....	....	....	....	7.25	7.25
Chicago, Cincinnati and Louisville	....	....	....	....	....	....	....	....	....	41.47	41.47
Chicago, Detroit & Can. Grand Trunk Junc.	....	....	....	....	....	....	....	....	....	62.80	62.80
Cincinnati, Hamilton and Indianapolis	5.50	8.00	14.30	....	....	....	....	17.80	39.30	....	84.90

	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	Decade.
Cincinnati, Indianapolis, St. Louis & Chicago	....	....	24 80	....	....	....	....	....	....	....	24 80
Cleveland and Mahoning Valley	....	....	13 36	....	....	....	....	....	....	35.41	48.77
Clove Branch	....	....	....	....	....	....	....	....	4.09	....	4.09
Colebrookdale	....	....	....	....	....	....	....	....	....	12.80	12.80
Columbia and Port Deposit	....	....	....	....	....	....	....	....	4 80	....	4.80
Columbus, Chicago and Indiana Central	60.20	....	....	50.00	70.00	....	....	....	....	....	180.20
Columbus and Hocking Valley	....	....	....	....	....	....	....	....	31.13	30 52	61.65
Connecting	....	....	....	....	....	....	....	....	7 31	....	7.31
Corning, Cowanesque and Antrim	....	....	....	....	....	....	....	....	....	16.00	16 00
Cumberland and Pennsylvania	....	....	....	....	....	10.25	2.41	....	....	....	12 66
Delaware	....	....	....	....	....	....	....	....	....	16 67	16.67
Delaware and Chesapeake	....	....	....	....	....	....	10.00	14.00	....	....	24.00
Delaware and Hudson Canal	....	2.12	2 62	....	....	....	....	....	....	....	4.74
Detroit, Lansing and Northern	....	. ..	....	....	....	....	....	....	....	36 80	36.80
Dorchester and Delaware	....	....	....	....	....	....	....	....	....	25.00	25 00
East Brandywine and Waynesburg	....	16 00	....	....	....	....	....	....	....	....	16.00
East Mahanoy	7.54	0 92	....	1.01	0.33	....	....	....	....	....	10.70
Eastern Shore	6.00	....	....	....	....	....	32 00	....	....	....	38.00
Ebensburg and Cresson	....	....	11.00	....	....	...	....	....	....	....	11.00
Erie and Pittsburgh	....	....	....	....	....	....	84.47	....	....	....	84.47
Evansville and Terre Haute	21 88	....	....	....	....	....	. ..	....	....	....	21.88
Fairland, Franklin and Martinsville	....	....	....	....	....	....	....	12 00	....	....	12.00
Flint and Pere Marquette	....	....	34.00	....	17.00	....	....	32.35	5.00	....	88.35
Flushing, North Shore and Central	....	....	....	....	....	....	....	6 74	....	4 00	10.74
Fort Wayne and Jackson	....	....	....	....	....	....	....	....	....	36.00	36.00
Fort Wayne, Muncie and Cincinnati	....	....	....	....	....	....	....	12.50	13.40	18.00	43.90
Freehold and Jamesburg Agricultural	....	....	...	....	....	....	....	....	7 61	....	7.61
Glen Falls	....	....	....	....	....	....	....	....	....	5.74	5.74
Goshen and Deckertown	....	....	....	....	....	....	....	....	....	11 65	11.65
Grand Rapids and Indiana	....	....	....	....	....	....	....	....	....	40.40	40.40
Grand River Valley	....	....	....	....	....	....	....	....	24.26	26.66	50.92
Harlem Extension	....	....	....	....	....	....	....	....	....	58.00	58.00
Harrison Branch	....	....	....	....	7.75	....	....	....	....	....	7.75
Hecla and Torch Lake	....	....	....	....	....	....	....	4.17	....	....	4.17
Hibernia Mine	....	....	....	4 00	....	....	....	....	....	1.50	5.50
Hoboken Land and Improvement	....	....	....	....	....	....	....	....	3.21	....	3.22
Huntingdon and Broad Top Mountain	....	....	3.25	12.57	....	....	....	....	....	....	15.82
Indianapolis and Vincennes	....	....	....	....	....	....	....	....	....	116.63	116.63
Ironton	5.00	...	....	....	5.00	....	....	....	....	....	10.00
Jackson, Lansing and Saginaw	....	7.00	....	0 90	....	24.49	12.15	49.88	....	....	94.62
Jamestown and Franklin	....	....	....	....	....	....	42.91	....	....	....	42.91
Jefferson	....	....	....	....	....	....	....	....	....	8.18	8.18
Jeffersonville, Madison and Indianapolis	....	....	....	....	....	4 54	....	....	....	....	4 54
Junction	....	....	....	....	....	....	3.68	....	....	....	3.68
Junction and Breakwater	....	....	....	....	....	....	....	....	....	16.00	16.00
Kalamazoo, Allegan and Grand Rapids	....	....	....	....	....	....	....	....	25.21	33.21	58.42
Kalamazoo and White Pigeon	....	....	....	....	....	....	....	25.27	....	....	25.27
Kent County	....	....	....	....	....	....	....	....	10.00	5.00	15.00
Lake Erie, Evansville and South-western	....	....	....	....	....	....	....	....	....	7.38	7.38
Lake Erie and Louisville	....	....	....	....	....	....	....	20.84	....	....	20.84
Lake Erie and Western	30.70	....	....	....	....	....	....	....	....	....	30.70
Lawrence	.:..	....	....	....	....	....	....	17 98	....	....	17.98
Lehigh Coal and Navigation	....	....	....	....	....	8.20	67.80	....	46.70	....	122.70
Lehigh and Lackawanna	....	....	....	....	....	....	....	15 00	....	....	15.00
Lehigh Valley	1.21	18 25	....	23.00	....	17.00	42.66	30.65	....	3.32	136.09
Lewisburg Bridge	....	....	....	....	....	....	....	....	....	0.24	0.24
Lewisburg and Tyrone	....	....	....	....	....	....	....	....	....	1.26	1.26
Lewistown and Tuscarora	....	....	....	....	0.11	....	....	....	....	....	0.11
Long Branch and Sea Shore	....	....	....	....	....	11.00	....	....	....	....	11.00
Long Island	10.25	....	....	....	12.96	....	....	....	11.07	35.20	69.48
Lykens Valley	....	....	....	....	....	5 19	....	....	....	....	5.19
Marietta and Cincinnati	....	....	....	....	....	....	17.50	....	....	....	17.50
Marquette, Houghton and Ontonagon	....	....	....	....	....	16.00	....	....	1.04	....	17.04
Massilon and Cleveland	....	....	....	....	....	....	....	....	....	12.23	12.23
Michigan Air Line	....	....	....	....	....	....	....	....	....	14.10	14.10
Middleburg and Schoharie	....	....	....	....	....	....	....	....	5.75	....	5.75
Middletown, Unionville and Water Gap	....	....	....	....	....	....	....	....	13 90	....	13.90
Mifflin and Centre County	....	....	....	....	12.42	....	....	....	....	....	12.42
Montgomery and Erie	....	....	....	....	....	....	....	10.22	....	....	10.22
Morris and Essex	....	....	....	....	7.21	23.55	0.51	....	....	....	31.27
Mount Holly, Lumberton and Medford	....	....	....	....	....	....	....	....	....	6.19	6.19
Mount Hope Mineral	....	....	....	....	....	....	....	3.50	....	....	3.50
Newburgh, Dutchess and Connecticut	....	....	....	....	....	....	....	....	43.90	15 52	59.42
Newburgh and New York	....	....	....	....	....	....	12 59	....	....	....	12.59
New Castle Railroad and Mining	....	....	....	....	....	....	....	5.00	....	....	5 00
New Castle and Beaver Valley	....	....	....	14.98	....	....	....	....	....	....	14.98
New Jersey Southern	5.00	....	73.00	....	....	....	7.50	....	....	....	85.50
Newry	....	....	....	....	....	....	....	....	....	1 00	1.00
New York and Canada	....	....	....	....	....	....	....	....	15.38	4 44	19.82
New York Central and Hudson River	....	....	....	....	....	....	....	40.29	....	....	40.29
New York and Fort Lee	....	....	....	....	....	....	....	....	1.79	....	1.79
New York, Lake Erie and Western	....	....	....	....	....	....	....	0.10	....	....	0.10
New York, Ontario and Western	....	....	....	....	....	....	....	....	....	100.00	100,00
New York, Pennsylvania and Ohio	34.00	27.00	101.00	147.00	103.91	....	8.78	....	....	....	421.69

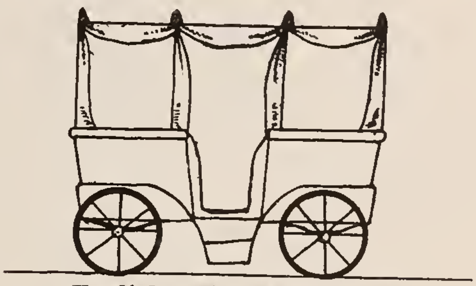
	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	Decade.
Northern Coal and Iron								18.89			18.89
Ogden Mine							10.80				10.80
Oswego and Rome							28.49				28.49
Paterson, Newark and New York									10 91		10.91
Peach Bottom									4.00		4.00
Pemberton and Hightstown									24.47		24.47
Pennsylvania			3.95	1.33			4 02				9.30
Pennsylvania Coal			15.61								15.61
Pennsylvania and New York Canal and R. R.								51.96		53.86	105.82
Perkiomen									6.00	5.03	11.03
Perth Amboy and Woodbridge					6.30						6.30
Philadelphia and Baltimore Central							22.00		8.00	7.00	37.00
Philadelphia and Erie			49.70	67.50	24.29						141.49
Philadelphia and Reading		1 90					64.60	42.20	1 20		109.90
Philadelphia, Wilmington and Baltimore							3.76				3.76
Pittsburgh, Cincinnati and St. Louis						43.14					43.14
Pittsburgh and Connellsville						34.80					34.80
Pittsburgh, Titusville and Buffalo			27.80					111.80			139.60
Queen Anne and Kent										4.00	4 00
Reading and Columbia				26.00	13.57		8.00		1.60		49.17
Rocky Hill Railroad and Transportation						6.53					6.53
Rocky River									5.53		5.53
Rome, Watertown and Ogdensburg			19.50								19.50
Salem							16.58				16.58
Schoharie Valley							4.38				4.38
Shenango and Allegheny										20.50	20.50
Skaneateles								5.00			5.00
South Branch				15.50							15.50
Southfield Branch									1.00		1.00
State Line and Sullivan									24.00		24.00
Staten Island	13.00										13.00
Sterling Mountain						7.60					7.60
Summit Branch						0.82					0.82
Swedesborough										10.80	10.80
Tioga								4.00			4.00
Tyrone and Clearfield					20.50	8.90		1.91		18.65	49.96
Ulster and Delaware										12.00	12.00
United New Jersey Railroad and Canal							5.52				5.52
Utica and Black River							9.50		14.10		23.60
Utica, Chenango and Susquehanna Valley									21.48	24.77	46.25
Vincentown branch of the Burlington County									2.84		2.84
Walkill Valley										12.27	12.27
Warwick Valley		10.16									10.16
Washington County								24.25			24.25
Waverly and State Line								0.25			0.25
West Jersey	41 90				41.60						83.50
Western Maryland		22.60									22.60
Western Pennsylvania					11.00		28.50				39.50
White River							18.00	36.00	8.00		62.00
White Water								23.00			23.00
Wilmington and Northern										33.00	33.00
GROUP III. VIRGINIA, WEST VIRGINIA, KENTUCKY, TENNESSEE, MISSISSIPPI, ALABAMA, GEORGIA, FLORIDA, NORTH CAROLINA, SOUTH CAROLINA.											
Alabama Central			51.00								51.00
Alabama Great Southern									43.00	82.00	125.00
Atlantic, Gulf and West India Transit	9.00										9.00
Atlantic, Tennessee and Ohio		48.00									48.00
Brighthope								3.00			3.00
Cape Fear and Yadkin Valley	29.00	2.00									31.00
Charlotte, Columbia and Augusta								84.60			84.60
Chesapeake and Ohio									10.34	21.74	32.08
Cincinnati, Cumberland Gap and Charleston		40.00									40.00
Eastern Kentucky								12.00			12.00
Georgia Southern										26.20	26.20
Jacksonville, Pensacola and Mobile		83.00						24.00			107.00
Knoxville and Augusta								16.00			16.00
Knoxville and Ohio	9.00						23.00			7.19	39.19
Laurel Fork and Sand Hill							3.50	2.00			5.50
Louisville, Cincinnati and Lexington										81.00	81.00
Louisville and Nashville	276 40								33.80		310.20
Macon and Brunswick	20.00	10.00	5.00	3.00		10.25				150.00	198.25
Mississippi and Tennessee	26.00	8.00									34.00
Mobile and Girard								9.00		9.00	18.00
Mobile and Montgomery		113.00	50.00								163.00
Mobile and Ohio	84.75	53.25									138.00
Montgomery and Eufala										40.00	40.00
Nashville, Chattanooga and St. Louis								182.00			182.00
New Orleans, Mobile and Texas									141.00		141.00
Owensborough and Nashville								35.00			35.00
Pensacola	44.50										44.50
Pensacola and Perdido										9.00	9.00
Piedmont				24.10	24.56						48.66



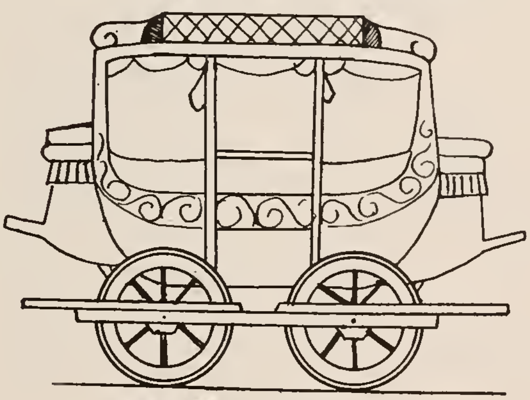
First Passenger Car.



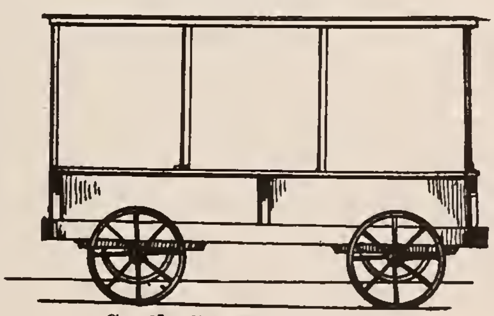
Private Coach on Truck.



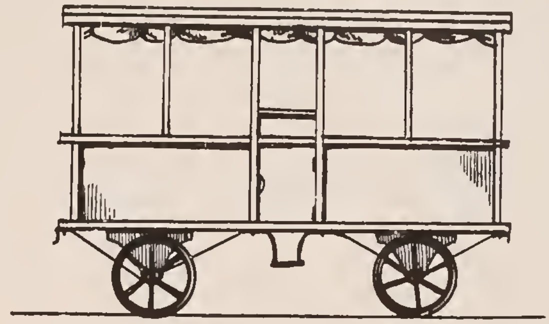
English Railway Omnibus.



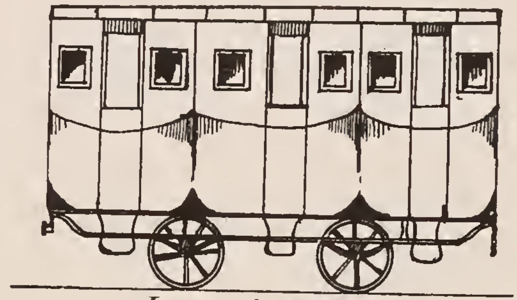
Early Mohawk Valley Car.



South Carolina R. R. Car.

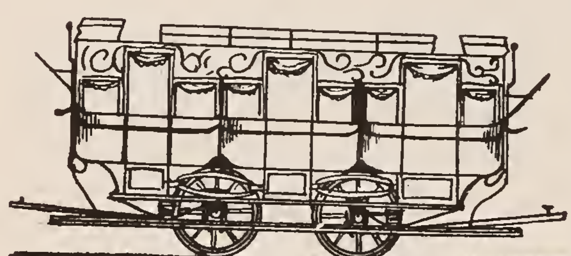


Early Car on B. & O.

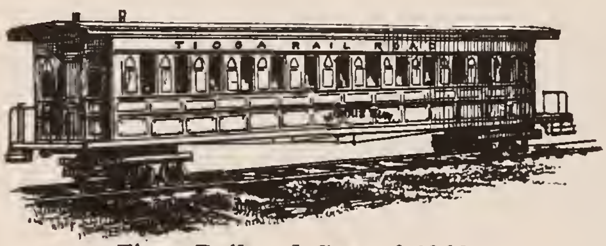


Improved English Car.

Car on Erie and Kalamazoo in 1837.



American Street Car of 1832.



Tioga Railroad Cars of 1840.

EARLY PASSENGER CARS.

	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	Decade.
Pontchartrain	....	....	....	....	....	....	....	....	5.00	....	5.00
Richmond, York River and Chesapeake	....	....	....	....	....	....	....	38.50	....	....	38.50
Rogersville and Jefferson	....	....	....	....	....	....	....	....	4.00	....	4.00
St. Louis and South-eastern (Tennessee div.)	37.16	....	....	....	....	....	....	....	....	....	37.16
Savannah and Charleston	98.00	....	....	....	....	....	....	....	....	....	98.00
Savannah, Florida and Western	....	131.80	....	....	....	....	....	36 00	49.30	24.00	241.10
Selma, Rome and Dalton	....	....	26.00	....	....	....	....	....	....	36.80	62 80
South-western, of Georgia	44.50	....	....	....	....	0.50	....	....	50.00	....	95.00
Vicksburg and Meridian	....	80.00	....	....	....	....	....	....	....	....	80.00
Washington and Ohio	37.50	....	....	....	....	....	....	....	....	7.50	45.00
Western North Carolina	71.00	....	....	....	....	....	....	10.00	....	....	81.00
Wilmington and Weldon	....	....	....	....	....	....	....	....	....	17.00	17.00
Group IV. Illinois, Iowa, Wisconsin, Missouri, Minnesota.											
Belleville and Southern Illinois	....	....	....	....	....	....	....	....	....	14.26	14.26
Boone County and Booneville	....	....	....	....	....	....	....	21.75	....	....	21.75
Booneville, St. Louis and Southern	....	....	....	....	....	....	....	....	25.75	....	25.75
Carthage and Burlington	....	....	....	....	....	....	....	....	....	30.41	30.41
Cedar Falls and Minnesota	....	....	....	....	....	....	14.00	....	28.00	25.10	67.10
Cedar Rapids and Missouri River	....	....	70.00	....	81.00	....	....	120.60	....	....	271 60
Central Iowa	....	....	....	....	....	....	....	....	16.00	27.50	43.50
Chicago and Alton	....	....	....	....	23.40	....	....	12.50	....	22.30	58 20
Chicago, Burlington and Quincy	....	....	....	....	....	37.75	25.95	30.90	50.90	96 66	242 16
Chicago and Eastern Illinois	....	....	....	....	....	....	....	....	....	32 93	32.93
Chicago, Milwaukee and St. Paul	13.45	....	....	....	10.00	46.00	138.30	150 03	5.60	39.98	403 36
Chicago and North-western	17.00	20.00	104.13	....	93.80	5.90	....	....	....	....	240.83
Chicago, Rock Island and Pacific	....	....	....	....	....	77.00	....	44.00	....	143.20	264.20
Chicago, St. Paul, Minneapolis and Omaha	....	....	....	....	....	....	....	....	20.50	33.80	54.30
Des Moines and Fort Dodge	....	....	....	....	....	....	....	....	....	72.80	72 80
Dubuque, Platteville and Milwaukee	....	....	....	....	....	....	....	....	10.00	....	10.00
Dubuque and Sioux City	....	20.00	....	....	....	....	42 89	....	....	....	62.89
Dubuque South-western	....	....	41.30	2.30	5.40	....	....	....	....	....	49 00
Dunleith and Dubuque Bridge	....	....	....	....	....	....	....	....	0.46	....	0.46
Grand Tower Mining, M'f'g & Transport'n.	....	....	....	....	....	....	17.58	....	6.81	....	24.39
Hannibal and St. Joseph	13.42	....	....	....	....	....	....	51.65	....	1.40	66.47
Illinois and St. Louis Railroad and Coal	....	....	....	....	....	7.00	....	....	....	....	7.00
Indiana, Bloomington and Western	....	....	....	....	....	....	....	....	....	202.30	202.30
Iowa Falls and Sioux City	....	....	....	....	....	....	....	....	....	48 89	48.89
Kansas City, St. Joseph and Council Bluffs	19.90	23.80	....	....	....	....	....	51.40	78.00	54.70	227.80
Keokuk and Des Moines	36.60	15.90	....	....	23.60	13.90	33.20	....	....	....	123.20
Missouri Pacific	13.50	7.50	....	7.00	22.00	64.00	1.00	....	....	....	115.00
Peoria, Pekin and Jacksonville	....	....	....	....	10.00	....	....	....	....	15 00	25.00
Quincy and Warsaw	....	....	....	....	....	....	....	....	....	39.72	39.72
St. Louis, Iron Mountain and Southern	....	....	....	....	....	....	....	....	....	120.00	120.00
St. Louis, Jacksonville and Chicago	44.50	....	....	8.00	37.00	....	....	61.10	....	....	150.60
St. Louis and San Francisco	58.00	....	....	....	....	....	....	....	....	71 00	129.00
St. Louis, Vandalia and Terre Haute	....	....	....	....	....	....	....	....	....	100.00	100.00
St. Paul and Duluth	....	....	....	....	....	....	....	....	20.00	60.00	80.00
St. Paul, Minneapolis and Manitoba	....	....	10.00	....	28.60	....	34.90	17 35	29.50	49.10	169.45
St. Paul and Sioux City	....	....	....	....	....	22.00	19.00	16.00	23.07	13.00	93.07
Sheboygan and Western	5.70	....	....	....	....	....	....	....	23.40	....	29.10
Sioux City and Pacific	....	....	....	....	....	....	....	54.76	20.99	31 77	107.42
Southern Minnesota	....	....	....	....	....	....	....	31.50	20.00	40 00	91.50
Toledo, Peoria and Warsaw	24.70	....	....	....	....	....	....	....	97.30	....	122.00
Wabash, St. Louis and Pacific	....	74.31	....	....	....	....	....	....	103.75	89 75	257.81
Winona and St. Peter	....	....	....	....	....	....	....	105 00	....	....	105.00
Group V. Louisiana, Arkansas, Indian Territory.											
Baton Rouge, Grosse Tête and Opelousas	....	24.00	....	....	....	....	....	....	....	....	24.00
Memphis and Little Rock	85.00	....	....	....	....	....	....	....	....	....	85.00
Vicksburg, Shreveport and Pacific	18.00	37.60	....	....	....	....	19.40	....	....	....	75.00
Group VI. Dakota, Nebraska, Kansas, Texas, New Mexico, Colorado, Wyoming, Montana, Idaho, Utah, Arizona, California, Nevada, Oregon and Washington.											
Atchison Topeka and Santa Fe	....	....	....	....	....	....	....	....	....	26.31	26.31
Black Diamond Coal Mining	....	....	....	....	....	....	....	....	6.00	....	6.00
California Northern	....	....	....	....	26 50	....	....	....	....	....	26.50
Cascade	....	....	....	6.00	....	....	....	....	....	....	6.00
Central Branch Union Pacific	....	....	....	....	....	....	....	....	100.00	....	100.00
Central Pacific	....	....	....	....	31.25	22.94	37.72	21.51	315.25	495 21	923.88
Fremont, Elkhorn and Missouri Valley	....	....	....	....	....	....	....	....	....	10 00	10.00
Gulf, Western Texas and Pacific	....	....	....	....	....	....	....	....	....	38.00	38.00
Houston and Texas Central	9.50	....	....	....	....	....	....	19.10	21.29	8.20	58.09
International and Great Northern	49.82	....	....	....	....	....	....	....	....	....	49.82
Kansas City, Fort Scott and Gulf	....	....	....	....	....	....	....	....	21.00	77.10	98.10
Kansas City, Lawrence and Southern	....	....	....	....	....	....	....	26.83	....	14.90	41.73
Leavenworth, Atchison and North-western	....	....	....	....	....	....	....	....	....	21.00	21.00
Missouri River	....	....	....	....	....	....	26.00	....	....	....	26.00
Oregon and California	....	....	....	....	....	....	....	....	....	20.00	20.00
Oregon Railway and Navigation Company	....	....	....	13.30	....	....	....	....	....	....	13.30
Pittsburgh	....	....	....	....	....	....	5.33	....	....	....	5.33

	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	Decade.
Sacramento and Placerville	....	....	....	....	....	26 23	....	....	....	....	26.23
Southern Pacific	....	....	....	15.10	34.90	....	....	....	15.80	36 56	102.36
Texas and New Orleans	64.85	40.25	....	....	....	....	....	....	....	....	105.10
Texas and Pacific	....	....	....	....	20.40	....	....	....	....	....	20.40
Union Pacific	....	....	....	....	38.10	68.50	361.27	446.43	474.00	138.74	1,527.04
Vaca Valley and Clear Lake	....	....	....	....	....	....	....	....	....	5.00	5.00
Virginia and Truckee	....	....	....	....	....	....	....	....	....	22.00	22.00

EFFECTS OF THE CIVIL WAR ON RAILWAYS.

CONSTRUCTION dwindled from 1,499.72 miles in 1860 to 573.90 miles in 1863, and then subsequently increased from 812.72 miles in 1865 to 4,102.65 miles in 1869, the latter being the largest amount of construction in any one year up to that period; and there are various other striking peculiarities in the amount of construction in particular sections and the entire country in various years, such as the completion of only 10.75 miles in the entire group of Southern states in 1865 and the temporary cessation of all new construction in the Southwestern and far Western states and territories.

A partial explanation of these developments and of various other matters of great moment is furnished by the fact that the seventh decade marks the commencement of a new era in the transportation history of the country, which has its salient features based partly on the events and influences heretofore described and partly on changes wrought by the civil war which commenced in 1861 and ended in 1865.

RAILWAYS AS MILITARY ADJUNCTS.

Although few or none of the early railways of this country had been built with reference to military requirements, they rendered invaluable assistance to the organizers of each of the contending armies in facilitating the prompt movement of men, munitions, and supplies; and in a financial point of view the effects of the war, as an entirety, were very beneficial to a number of the northern railways and disastrous to the southern lines.

The current of trade down the Mississippi was necessarily arrested by the progress of hostilities, and the east-bound movement of western produce, via the lakes, the Ohio river, and western connections of the trunk lines, received an extraordinary impetus from the eastern demand for breadstuffs and provisions. The business of the northern trunk lines increased very rapidly, and their position as channels of interstate commerce was greatly improved by the double process of the closing of the Mississippi river route and the temporary annihilation of the rivalry of southern routes. A number of important northern railways suddenly obtained marked additions to their current revenue, through the movement of soldiers and citizens to and from the armies, and the great increase in the demand for all classes of articles that could be used either for peaceful or warlike purposes. Roads that had been on the verge of bankruptcy were enabled to earn large dividends. The anthracite coal carriers were benefited to an extraordinary extent.

The reverse of all this occurred in reference to a number of the southern lines, notwithstanding temporary advantages they also derived from military traffic, as the course of events tended to make some of them the victims of both armies, and when hostilities ended they were left in a deplorable condition.

ARMED ATTACKS ON RAILROADS.

While very remarkable mechanical and engineering advances were made in the seventh decade in a number of directions, as well as considerable additions to mileage, the radical improvement of many lines was greatly retarded by the events and exigencies of the war, the pressure of demands for increased accommodations of special kinds, and the enhanced cost of labor and materials. Everything happened to some railroads during the war that seemed within the bounds of possibility, from partial to nearly entire destruction, from pecuniary injuries of the direst nature to a temporary increase of traffic and profits that exceeded the wildest dreams of stockholders and creditors. Interwoven with everything else there were alarming elements of uncertainty. Lines in the border states, or adjacent to them, which were never seriously injured by armed foes, or never even attacked, were subjected, on sundry occasions, to imminent danger, or at least to well-grounded apprehensions that they might be made objective points of irresistible raids. Railways were the most assailable things in any section exposed to hostile inroads, and they represented the kind of property that invading armies were most anxious to injure or destroy. Aside from the actual devastation of lines which temporarily fell under the control of an antagonistic force, great efforts of railway companies or their officers in the way of securing timely military protection were at some critical junctures believed to be necessary to avert such calamities. Occasionally a large portion of the working railway force was temporarily pressed into military service, such as helping to throw up entrenchments at exposed strategic points, or arms were freely distributed among them, and they were drilled in their use, for their own protection and the protection of their roads. On other occasions large quantities of rolling stock were temporarily sent to sections of a road considered least liable to attacks, and kept there for days in idleness, even at periods when a pressing need for its activity existed, until some specially critical danger had passed.

Current developments abound, to a distressing extent, with reminders of the perils to which various classes of train men are exposed, and their ordinary duties approximate in danger to those assumed by soldiers, but during the war it sometimes became necessary for some classes of railway employés or officials to assume extraordinary hazards, and they were practically converted into soldiers.

THREATENED ATTACK ON RAILROADS OF PENNSYLVANIA.

At the time of the invasion of Pennsylvania by the Confederate forces under General Lee, in 1863, fears were entertained that the lines of the Pennsylvania Railroad Company, and some of the anthracite roads, and even the anthracite coal mines, would be greatly injured, and these apprehensions prompted earnest efforts, on the part of the officers of the Pennsylvania Railroad Company, to incite Federal and state authorities to make timely defensive preparations, which had a very important effect upon the great struggle that occurred. It is within the personal knowledge of the writer that when appeals for such action were first made they excited much ridicule, although the subsequent course of events showed that a very pressing necessity then existed for the course recommended. While the battle of Gettysburg was progressing immense quantities of rolling stock were concentrated on portions of the line of the Pennsylvania Railroad near Philadelphia, and the following reference to this subject was made in the annual report of Enoch Lewis, then general superintendent, for the year ended December 31st, 1863:—

"In June last, the presence of a hostile army within the borders of the commonwealth, caused the through freight traffic to be suspended, and the passenger business to be very much curtailed for several weeks, but though the close proximity of the enemy rendered it prudent to remove temporarily from the Middle division the rolling stock to a place of safety, yet the whole property of the company escaped untouched and unharmed, and it was enabled, as soon as the danger was removed, to resume its operations in full, and with very little delay."

There were many similar events of varying significance, including numerous cases in which success crowned efforts of parties sent to injure railways, by tearing up tracks, destroying bridges, and capturing rolling stock, in other portions of the country, to some of which more particular reference is made elsewhere.

INJURIES INFLICTED ON THE BALTIMORE AND OHIO.

The following extracts from the Baltimore and Ohio annual report, made on October 1st, 1863, not only shows what occurred on that road while it was under control of a hostile force, but typifies similar proceedings elsewhere when Union armies gained possession of southern railways they desired to cripple, or when Confederate armies desired to injure southern roads that had fallen under control of Union forces. The Baltimore and Ohio report says:—

"General possession was taken by the Confederate forces on May 28th, 1861, of more than one hundred miles of the main stem, embracing chiefly the region between the Point of Rocks and Cumberland. Occasional movements were also made, accompanied by considerable destruction, upon the roads between Cumberland and Wheeling, and Grafton and Parkersburg, during this fiscal year.

The protection of the Government was not restored throughout the line until March, 1862, when the reconstruction was pressed with great energy, and the road reopened on the 29th of that month.

During this period the destruction of the property, bridges, and tracks of the company was of the most extensive and serious character.

The large and costly machine shops and engine houses at Martinsburg were greatly damaged. Fourteen locomotives and tenders, and a large number of cars, much machinery from the shops, and portions of nine additional engines, were taken from the road, and transported, by animal power, over turnpikes to southern railways, and thus entirely lost to the company.

Forty-two locomotives and tenders; 386 cars, chiefly coal; 23 bridges, including 3 between Cumberland and Wheeling, 3 on the North-western Virginia road, and the great bridge at Harper's Ferry, embracing 127 spans, and a total length of 4,713 feet, were also destroyed, or damaged to a great extent by fire, and numerous engines and cars were thrown into the Potomac, Opequan, and other streams. Thirty-six and a half miles of track were torn up, and the iron and track fixtures removed for use on southern roads. The lines of telegraph for 102 miles, two water stations, and much other valuable property were also destroyed."

INJURIES INFLICTED ON VARIOUS SOUTHERN ROADS.

The New Orleans, Jackson and Great Northern Railroad was greatly improved in capacity, and amount of rolling stock during 1861, and it was reported that on January 1st, 1862, the line from New Orleans to Canton, Mississippi, was in superior condition. On April 24th, 1862, the rolling stock and locomotives were taken possession of by Major General Lovell of the Confederate army, and removed to the northern part of the road, where it remained under his absolute control for twenty days. It was then restored to the officers of the road and operated by them during the remaining years of the war, subject to the control of the Confederate military authorities, so far as operations of any kind were possible in view of the severe injuries inflicted by raids of Union forces, or contests at various periods between the contending armies. In 1863 and 1864 the locomotives and cars were nearly all destroyed. At the close of hostilities the line was in the possession of the Union army, and at that time it was being used and in good condition between New Orleans and as far north as Ponchatoula, 47 miles north of New Orleans. But from that point to Brookhaven, a distance of 81 miles, the road had not been used after the spring of 1863, as most of its bridges had been destroyed, and at various places cross ties had been burnt or rendered unfit for use by decay. Other portions of the road were also much damaged. Of 49 locomotives, 37 passenger cars, and 550 freight, baggage, and gravel cars, there remained fit for use, though in a damaged condition, between Jackson and Canton, only one locomotive, two second-class passenger cars, one first-class passenger car, one baggage and one provision car, two stock and two flat cars. About the same proportion of the original rolling stock was available on other divisions. The amount turned over by the military authorities at New Orleans, consisted of one locomotive, one passenger car, four box and ten flat cars, one baggage and two cattle cars. Nearly all the stations, depots, platforms, wood sheds, and water stations along the line had also been destroyed.

On the Memphis and Charleston Railroad, at a critical stage of the campaign of 1862, both armies fought for the control of the road and rolling stock, and after the Confederate forces retired southward they removed all the machinery and rolling stock they could seize to points further south. In the struggle that ensued an important bridge was burned and some of the rolling stock was destroyed. A large portion of the rolling stock taken from the Memphis and Charleston was distributed among other southern railroads under Confederate control, and most of it was subsequently burned by either the Union or the Confederate troops. When portions of the Memphis and Charleston fell under Union control, and Union forces endeavored to put it in good condition, it was subjected to destructive attacks by the Confederates, and when portions of its track or rolling stock were useful to Confederate armies, they became objective points of the hostile operations of Union forces. A similar state of things existed, at various periods, on other southern roads, so that they were literally the prey of both armies. When the line was finally surrendered to the company, after the close of the war, there was a division, from Pocahontas to Decatur, 114 miles in length, which had been almost entirely destroyed, except the road-bed, the iron rails being bent or twisted or otherwise in very bad condition, the bridges, trestles, and station buildings nearly all burned and the cross-ties decayed.

Another southern railroad, portions of which alternately fell into the possession of each of the contending armies, and which was of great service to the Confederates, was the Orange and Alexandria, extending from Alexandria, in Virginia, to Lynchburg, in the same state, a distance of 178 miles. Although portions of this line, and also sections of the Virginia Central and the Petersburg and Richmond roads, were occasionally injured by raids of Union cavalry, great efforts were made by the Confederates to secure speedy repairs, which were generally successful, supplies of new rails, all other requisite materials, and construction trains being kept constantly in readiness for reconstruction.

A number of other southern railroads were subjected to injuries similar to those already described. Their condition at the close of the war was deplorable, but the difficulty of restoring their usefulness was, to some extent, diminished by the policy pursued by the United States government in the summer of 1865, in permitting them to purchase, on long credits, the locomotives and cars it then owned in the Southern states.

In addition to all the other losses to which southern railways were subjected by the war, incidental injuries of considerable magnitude resulted from the prolonged postponement of the construction of the Southern Pacific Railway, and the adoption of measures which made the Central and Union Pacific the first of the transcontinental lines.

VITAL RAILWAY QUESTIONS ENGENDERED BY THE WAR.

After the war was over, the continuance of a high standard of wages and prices of materials, coupled with great uncertainty in regard to the future financial policy of the Government, a decline in some classes of revenue, and urgent demands for new expenditures in special directions, led to the postponement of radical improvements undertaken at a later period, and especially about or soon after the commencement of the eighth decade. Traces of another influence are to be found in a number of the reports of the seventh decade, which materially affected the policy of some companies, in reference to all new classes of expensive outlays. It was a strong disposition to apply extra profits earned during the war to the reduction of bonded indebtedness. In a few cases this course was actually pursued, but what happened in many other cases would perhaps be more accurately described by a statement that it was only at or near the time when deliverance from the demands of permanent creditors had been hoped for that the process of contracting loans on a gigantic scale was fairly commenced. Companies engaged in extensive competitive struggles with energetic and ambitious rivals were compelled to choose between the loss of important portions of their traffic, or practical decadence, and large additions to their capital, to be expended in acquisition or control of extensions, branches, or connections, increase of rolling stock, substitution of steel for iron rails, erection of improved bridges and stations, avoidance of defective drainage, creation of terminal facilities, and various other classes of improvements. It was a crucial era for many of the railway corporations of the country, and the course finally adopted by progressive lines, as a result of their deliberations and the pressure of events during this era, represented one of the most rapid advances that has ever occurred in the industrial world, which was necessarily accompanied with corresponding outlays.

The enormous issue of greenbacks during the war, and consequent inflation of the currency, coupled with the increased earnings and large dividends of northern railways, and the reported profits of the constructors of the first Pacific roads, gave a tremendous impetus to stock speculation, speculative construction, and the organization of gigantic railway systems. Previous experience furnished no precedents for startling new developments which rapidly succeeded each other. Although construction was severely checked during the early years of the war, preparations for renewing it on a scale of unparalleled magnitude were completed soon after the cessation of hostilities, and even while the war was progressing some stupendous and disastrous schemes, notably the Atlantic and Great Western, subsequently known as the New York, Pennsylvania and Ohio, were floated.

NEW CONSTRUCTION IN VARIOUS SECTIONS.

As at all other periods, a large proportion of the new construction of the seventh decade was intended to furnish minor additions to established lines or to provide new local facilities for districts that had not previously obtained them. Incidentally similar ends are served by lengthy new roads, and this fact forms one of the principal causes of the success of efforts to secure the means requisite for their completion, inasmuch as the aid of many auxiliary political, social, and property influences are secured. It will be seen that in all

THE NEW ENGLAND STATES

no line constructed or added to its mileage more than 71.14 miles, which is the amount reported by the Old Colony. The new work of that section of greatest significance, was probably that done in connection with the Hoosac Tunnel, as it involved expenditures of a magnitude never before attempted on a tunnel in this country, with means provided by the commonwealth of Massachusetts, for the purpose of improving the railroad avenues through her western borders to the Hudson and railways extending through New York to the western states. The direct returns for enormous outlays for the Hoosac Tunnel, in the way of interest on the cost of construction, have been infinitesimal. It was commenced before 1860 and not finished until after 1870. Its length is a little less than five miles. Originally its anticipated cost was about $2,000,000, but on account of various kinds of mismanagement and delays and difficulties, including changes from the supervision of contractors to commissioners appointed by the state, and a return to the contractor system, the final cost was about five times the amount of the first estimates.

IN THE MIDDLE STATES

the period was one of great prosperity for railway interests, and this fact stimulated the construction of numerous short lines, connecting links of considerable significance, and the completion of several important new roads.

The greatest amount of new mileage reported by any single company is 421.69 by the New York, Pennsylvania and Ohio, known as the Atlantic and Great Western during the early years of its unfortunate financial career, and extending from Salamanca, in New York, through Pennsylvania, to southwestern Ohio. The fact that it was built mainly during the years when the war was progressing, when wages and materials of all kinds were unusually high, materially increased the cost of the undertaking, but in sundry other respects, and especially in the extent to which its controlling management was in foreign hands, a broad ground-work was laid for an exceptionally poor return, or, rather, lack of any return whatever, for much of the capital invested. While the work was progressing, and approaching completion, great expectations of its profitableness were cherished. It was stated that more than five thousand laborers had been brought across the Atlantic while the civil war was progressing for the express purpose of building this line; that on the portions of the road completed and in operation in 1864 results greatly exceeded the calculations of the promoters of the line, the net earnings being greatly in excess of the 7 per cent. payable on the bonds, and a part of the system which traversed the oil regions earning a dividend of 25 per cent. for the first year's working.

The longest new line constructed in New York was the Albany and Susquehanna, between Binghamton and Albany, 142.11 miles, which now forms the Susquehanna division of the Delaware and Hudson Canal Company's system of New York roads. Of the New York, Ontario and Western, 100 miles were constructed, and this formed the second largest amount of new mileage completed by any single company whose lines were located exclusively in New York.

In Pennsylvania the new construction was of considerable magnitude and importance, especially in connection with coal and petroleum operations, and the creation of additional facilities for carrying anthracite and bituminous or semi-bituminous coal and petroleum from points of production to various markets. The additions to the mileage of anthracite roads include the following: Lehigh Coal and Navigation, 122.70; Lehigh Valley, 136.09; Pennsylvania and New York Canal and Railroad, 105.82; Philadelphia and Reading, 109.90. Several new roads, which were expected to move considerable amounts of bituminous coal, were constructed, and others penetrated districts which contained both bituminous coal and petroleum. These classes include the Huntingdon and Broad Top Mountain, 15.82 miles; Bald Eagle Valley, 53.87; Pittsburgh, Titusville and Buffalo, 139.60; Shenango and Allegheny, 20.50; Tyrone and Clearfield, 49.96, and various other roads.

The Philadelphia and Erie, by which, in connection with earlier lines, a direct rail connection was secured between Lake Erie and the south-eastern portion of Pennsylvania, was completed in 1864, after the project had been agitated for about thirty years. It made an addition of 141.49 to the railway mileage of the state, and its lines, like a considerable amount of other new mileage of that period in Pennsylvania, New Jersey, Ohio, and Indiana, passed under the control of the Pennsylvania Railroad Company. Such additions include the Bald Eagle Valley and Tyrone and Clearfield, already named, and the following additional new mileage constructed during the decade, viz.: Allegheny Valley, 24; Connecting (by which convenient modes of connecting the main line in Pennsylvania with the present New York division were supplied), 7.31; Erie and Pittsburgh, 84.47; Western Pennsylvania, 39.50; various lines in New Jersey, one of the longest of which is the West Jersey, 83.50; Grand Rapids and Indiana, 40.40; Columbus, Chicago and Indiana Central, 180.20; Pittsburgh, Cincinnati and St. Louis, 43.14, and several other roads. The decade was peculiarly prolific in extensions of the Pennsylvania Railroad system through acquisitions of new mileage, as well as of roads that had been built previous to 1860.

IN THE SOUTHERN STATES

more new mileage was constructed in 1860, before the war commenced, and even in 1861, before its effects had been severely felt in interior sections, than in any of the other years of the seventh decade. Extensive and prolonged preparations for new construction led to marked activity in connection with some lines during the first two years of the decade, while in other sections considerable activity was displayed a few years after the close of hostilities. The entire number of new roads was comparatively small. The new mileage of greatest amount was that constructed by the Louisville and Nashville, 310.20 miles. The other additions approaching or exceeding 100 miles each were the following: Alabama Great Southern, 125; Charlotte, Columbia and Augusta, 84.60; Jacksonville, Pensacola and Mobile, 107; Macon and Brunswick, 198.25; Mobile and Montgomery, 163; Mobile and Ohio, 138; Nashville, Chattanooga and St. Louis, 182; New Orleans, Mobile and Texas, 141; Savannah and Charleston, 98; Savannah, Florida and Western, 241.10; Vicksburg and Meridian, 80; Western North Carolina, 81.

IN THE GROUPS COMPRISING ILLINOIS, IOWA, WISCONSIN, MISSOURI, AND MINNESOTA

the aggregate additions to mileage were large, and the number of new constructing companies comparatively small. The important western and north-western systems were materially expanded, particularly in connection with roads that traverse Missouri or radiate westward from Chicago. The companies that reported in 1880 new construction exceeding one hundred miles during the seventh decade include the following: Cedar Rapids and Missouri River, 271.60; Chicago, Burlington and Quincy, 242.16; Chicago, Milwaukee and St. Paul, 403.36; Chicago and North-western, 240.83; Chicago, Rock Island and Pacific, 264.20; Indiana, Bloomington and Western, 202.30; Kansas City, St. Joseph and Council Bluffs, 227.80; Keokuk and Des Moines, 123.20; Missouri Pacific, 115; St. Louis, Iron Mountain and Southern, 120; St. Louis, Jacksonville and Chicago, 150.60; St. Louis and San Francisco, 129; St. Paul, Minneapolis and Manitoba, 169.45; Sioux City and Pacific, 107.42; Toledo, Peoria and Warsaw, 122; Wabash, St. Louis and Pacific, 267.81; Winona and St. Peter, 105. Much of this new mileage was located west of the Mississippi, and a considerable portion was intended to furnish connections with Pacific roads. Land grants furnished to some of the companies a portion of the means requisite to complete their lines. Some of the new mileage was peculiarly fortunate in rapidly gaining and increasing earning power, and some of it has been very unprofitable to owners of the securities by which its capital is represented.

IN THE STATES AND TERRITORIES COMPRISED IN GROUP VI

the most notable event of the decade was the construction of Pacific railroads, embracing 100 miles by the Central Branch Union Pacific (which now forms part of the Missouri Pacific); 923.88 miles by the Central Pacific; 102.36 by the Southern Pacific; and 1,527.04 miles by the Union Pacific, including the mileage originally built by the Kansas Pacific and subsequently consolidated with the Union Pacific. The construction of these lines forms one of the most important events in American railroad history, and the character and amount of the financial aid given to them by the United States government has elicited much discussion and protracted congressional agitations.

In brief, a transcontinental line leading from the Missouri to the Pacific coast was considered a national necessity soon after the commencement of the war of 1861, and in 1862 an act providing for its construction was passed, which, in addition to granting a broad right of way, privilege of using materials on adjacent lands, and five alternate sections of public lands on each side of the roads, guaranteed to the amount of $16,000 per mile over comparatively level portions of the route, and $48,000 per mile on mountain divisions—this aid to be given in United States government bonds, payable in thirty years, for which the United States was to receive a first mortgage on the railroads comprising the line and branches. In 1864 it was claimed that this aid was not sufficient to secure rapid construction, and the law was so amended as to authorize the issue of first mortgage bonds on the roads to the amount of the Government bonds issued, which first mortgage bonds were to be made a prior lien, and the security for the Government advances converted into a secondary lien, or second mortgage. The land grant was also doubled so as to equal 12,800 acres to each mile of road. Under this arrangement construction progressed very rapidly. The companies sold their first mortgage bonds at rates not much below par, and had available for construction, the sums derived from this source, in addition to the Government bonds. The par value of these two classes of securities was $32,000 per mile for ordinary portions of the road and three times that sum for mountain divisions. It was alleged that the actual cost of original construction and equipment on a large portion of the route fell far below the gross amount of the proceeds of the first mortgage bonds and the Government bonds, and that this excess became a profit to contractors of the roads, who, by a peculiar arrangement, were substantially the corporators, and owners of the main portion of the stock. In securing the legislation by which these arrangements and various collateral and auxiliary details relating to the financial operations between the Pacific roads and the Government, were perfected, the friendly action of many senators and congressmen was necessary, and sundry charges have been made at various times which are based on the theory that questionable means were used to procure this favorable legislation. The fact that plans had been or could be devised to make Pacific railroads a tangible reality was clearly established, and the belief was widely disseminated that the particular financial methods adopted in connection with the first of the through transcontinental lines had rendered its construction a source of very substantial profits to the controlling parties.

In connection with the construction of the early Pacific roads, however, it should be remembered that for some time after active labors commenced, and, to a considerable extent, during nearly all the time their construction was progressing, wages and the cost of materials were far above the normal standard. In reference to a contract with a construction company to build one hundred miles of the main line of the Union Pacific directly westward from Omaha for $50,000 per mile, a Washington correspondent of the New York Tribune said, in August, 1865: "This contract for the construction of the road at $50,000 per mile has been the occasion of some comment. The Government directors, however, while they do not justify the action of the company in making this contract, have given to the Secretary of the Interior this explanation: That the law required certain sections of this road to be completed within a given period. The company were, consequently, compelled to commence their work at a time when gold was above 250, and when labor and iron and other materials were at a correspondingly high price. Reducing this $50,000, which was currency, to a coin standard, shows the actual cost to be less than $20,000 per mile, which cannot be considered an extravagant cost for a first-class railroad in that locality."

RAILWAY OPERATIONS FROM 1860 TO 1870.

THE seventh decade was probably the most prosperous period ever known, in the matter of enabling a number of northern and western railways to earn and declare large dividends. At the same time, it was one of the most unfortunate of eras in the way of stimulating competitive construction, and in infusing a reckless speculative spirit, which has rarely, if ever, been paralleled, into various railway operations. The enormous expenditures of the Government during the war, immense issues of greenbacks, contraction of a gigantic debt by the United States, and of large debts by many cities and counties, protracted suspension of specie payments, heavy premium on gold, which at one time rose to 185, and remained above 100 for a considerable period, large number of fortunes made by contractors and speculators in staple products, cotton goods, gold, petroleum, coal, bubble companies, and railway stocks, and other analogous influences, helped to bring about a state of affairs which apparently placed railways on a new basis. By many they were no longer regarded as struggling enterprises, which could scarcely hope for success unless they were carefully managed, and remarkably fortunate in their location and surroundings, but rather as bonanzas, which could scarcely fail to enrich all who were prominently connected with them, either in construction or operation. Roads that had previously been prosperous increased their dividends, and roads that had been on the verge of bankruptcy suddenly became profitable. It was not merely by a marked increase in the business of many lines, arising from the movement of troops, war material, and diversified products, that railways were benefited, but by the changes in the laws and usages relating to the currency, which enabled them to pay with greenback dollars debts, or the interest on debts, contracted on a gold basis, and thus conferred a liberal share of the sort of prosperity that helped to enrich all the debtor classes of that period who were engaged in active business. Many railway stocks advanced greatly in nominal value, not only on account of the large dividends earned, and inflation of the currency, but because an unusually large number of persons had suddenly acquired fortunes which they wished to invest, and as the standard rate of the dividends of a number of companies was about 10 per cent., and frequently more, they furnished one of the best of available investments.

PROFITS OF CONSTRUCTION.

In addition to the substantial returns of the older companies, it was generally believed, and in some cases there were apparently good grounds for such belief, that a number of large fortunes had been made out of the mere construction of railways, not only or mainly by the intricate process of superintending, as contractors, the operations of large numbers of men engaged in the actual work of tunneling or graduation, but by participation in the profits of construction companies, which made favorable bargains with coadjutors acting as directors. In connection with the Pacific roads subsidized by United States bonds, and various land-grant roads, devices for speedily securing profits out of construction were specially numerous, but even with other classes of roads, during eras when unbounded confidence in the success of railways prevailed, and when bonds could be readily sold, means were devised for rendering construction a profitable operation.

CHANGES IN BUSINESS SYSTEMS.

Aside from all temporary and speculative influences a radical and permanent change in many vital matters affecting the business of the country was progressing. The local and state spirit which had previously prevailed was, to a great extent, supplanted by broad nationalism. It was largely on account of this change that consolidations, the establishing of fast freight lines, or other methods for facilitating intercourse between distant points became popular. The entire Republic was opened up to all its citizens and the disposition to conduct commercial transactions with distant communities was greatly increased. Manufactures of many kinds began to flourish to an extent never known before, and as a substitute for a great temporary diminution in the exports of cotton, exports of petroleum, breadstuffs, and provisions began to assume tremendous proportions. After the close of the war, and the withdrawal of an immense number of men from military service, many of them sought new employment in comparatively new fields of agricultural development, such as portions of Texas and various western, north-western, or south-western states and territories, and also petroleum regions, and gold, silver, copper, lead, iron, and coal-mining districts. These outbursts of national activity each helped, in one way or another, to promote railway construction, by greatly expanding the area in which there was a demand for a marked increase of facilities for transportation.

DIVIDENDS OF THE SEVENTH DECADE.

The profitable nature of many of the railway operations of portions of the decade, is partly illustrated by the following statement of some of the dividends paid:—

Of the New England roads, the Boston and Albany, formed by a consolidation of the Boston and Worcester and the Western, which had paid dividends of 8 per cent. from 1859–60 to 1861–62, and a dividend of 9 per cent. in 1862–63, paid dividends of 10 per cent. per annum in each year from 1863 to 1869, and increased its capital stock from $9,650,000 in 1864 to $16,411,600 in 1869. The Boston and Maine paid dividends of 8 per cent. from 1862–63 to 1864–65 and of 10 per cent. from 1865 to 1869. The New York and New Haven, after large payments on account of the Schuyler fraud, to which it had been subjected, began to declare 10 per cent. dividends. A number of the short New England roads raised their annual rate of dividends to 10 per cent. before the close of the decade. The Boston and Providence paid dividends of 8 per cent. during five years of the decade, 9 per cent. in one year, and 10 per cent. in four years. The Boston and Lowell paid dividends of 8 per cent. from 1865 to 1869. A number of New England roads seem to have been less affected by the war than the lines of any other section. They were prosperous before and continued to be so. A table of the net earnings of seven railroads leading into Boston in 1860 and 1863 gives their net earnings in each of these years as follows:—

	1860.	1863.
Boston and Lowell	$197,909	$167,051
Boston and Maine	475,720	482,657
Boston and Providence	349,486	397,729
Boston and Worcester	439,285	488,358
Eastern	367,653	394,594
Fitchburg	302,400	328,042
Old Colony and Falt River	329,208	411,544

Of the Western, which, in combination with the Boston and Worcester, subsequently became the Boston and Albany, it was reported that its net earnings had increased from $888,254 in 1860 to $1,228,706 in 1863. Vigorous efforts to promote such a consolidation were progressing in 1864.

The Hudson River Railroad and the New York and Harlem, of both of which roads Cornelius Vanderbilt was president, each declared dividends of 8 per cent. or more during portions of the decade, prior to the consolidation of the New York Central with the Hudson River, which went into effect October 1st, 1869, after which time Cornelius Vanderbilt became president of the consolidated company. The Rome, Watertown and Ogdensburg declared dividends of 10 per cent. from 1863 to 1869. The New York Central paid a dividend of 7 per cent. in 1862–63, 9 per cent. in 1863–64, 6 per cent. from 1864 to 1868, and 8 per cent. in 1868–69. The Erie paid two dividends of 8 per cent. and one of 3½ per cent. on its common stock, and five dividends of 7 per cent. and one of 8½ on its preferred stock during the decade.

A committee of the New York Central reported in 1864 that the net earnings of that company had been sufficient to pay all interest on indebtedness, a 7 per cent. dividend, and to yield "a surplus of a million and a quarter of dollars, applicable to permanent increase and improvement of the company's property and reduction of debt." The committee suggested that at a future period the question should be duly considered "whether such large additions to the permanent value of the company's property ought not to be represented by a corresponding increase in value in the amount of its capital stock."

The United Companies of New Jersey paid a cash dividend of 10 per cent. during 1869, and permanently maintained that rate throughout the decade.

The class of companies which apparently profited most extensively by the events of the period were the anthracite railways. The Delaware and Hudson Canal Company paid a dividend of 8½ per cent. in 1862–63; of 20 per cent. in each of the two following years; of 16 per cent. in each of the two succeeding years; of 14 per cent. in 1867–68, and 10 per cent. in 1868–69. The Delaware, Lackawanna and Western declared a dividend of 9 per cent. in 1863; dividends of 20 per cent. in two of the years of the decade; a dividend of 15 per cent. in another year, and dividends of 10 per cent. in other years of the decade. The Lehigh Valley declared a dividend of 20 per cent. in 1865–66, and of 10 per cent. in six other years of the decade. The Philadelphia and Reading declared cash, stock, or optional dividends ranging from 5 to 15 per cent. in each year of the decade.

The Pennsylvania Railroad declared cash dividends ranging from 6 to 10 per cent. during each year of the decade and the following stock dividends: May, 1864, 30 per cent.; May, 1867, 5 per cent.; May, 1868, 5 per cent. Pennsylvania Railroad shares, par $50, were selling at from $75½ to $77½ shortly after a 30 per cent. stock dividend had been declared in the early part of 1864, so that the original holder of 100 shares which had cost $5,000 could have sold his dividend of 30 shares for from $2,265 to $2,325. The stock dividend represented surplus profits, applied to permanent improvements or investments, which had not been divided among the stockholders.

The net revenue of the Baltimore and Ohio was enormously increased while the war was progressing, and it declared substantial dividends, but applied a considerable portion of its net earnings to a reduction of its funded debt and sundry investments or improvements. A similar policy was pursued by the Philadelphia, Wilmington and Baltimore, which also had its net revenue largely increased above the usual standard during the war.

The prosperity of the Pittsburgh, Fort Wayne and Chicago is indicated by the fact that it was leased to the Pennsylvania in 1869, on terms which guaranteed a dividend of 7 per cent. on the capital stock, after the amount of the latter had been increased from $11,500,000 to $19,583,947.71. A prospectus issued in 1864 by promoters of a new company stated that in 1863 the Cleveland, Columbus and Cincinnati divided 15 per cent.; the Cincinnati, Hamilton and Dayton divided 10 per cent,; the Little Miami 30 per cent.; the Michigan Central 18 per cent.; and the Lake Shore, Cleveland, Painesville and Ashtabula, 23 per cent.

The Illinois Central paid dividends of 8 per cent. in 1863 and 1864, and of 10 per cent. from 1865 to 1869, inclusive. The Chicago and Rock Island paid dividends of 6 per cent. in 1860–61, 1861–62, and 1862–63; a dividend of 8 per cent. in 1864–65, and dividends of 10 per cent. in each of the four following years. The Michigan Central declared dividends of 8 per cent. in 1862–63; 12 per cent. in 1863–64; 18 per cent. in 1864–65; 9 per cent. in 1865–66, and 10 per cent. in each of the three following years of the decade. The Chicago, Burlington and Quincy declared large dividends, and also distributed a considerable amount of stock. The Chicago and North-western in 1867–68 declared a dividend of 10 per cent., payable in stock, and in 1868–69 a dividend of 10 per cent., payable in cash. The Milwaukee and St. Paul, the forerunner of the Chicago, Milwaukee and St. Paul, declared a dividend, from the earnings of 1869, on preferred stock of 7 per cent., and 3 per cent. on common stock, and on common stock of 3 per cent. in cash, and 7 per cent. in common stock.

Various other dividends of the period are of a character similar to those already mentioned. So far as any general deduction can be drawn from them, it is probably to the effect that the prevailing standard of the period for prosperous railways more nearly approximated 10 per cent. per annum than any other figure, and that sanguine investors were more apt to suppose that this rate would be maintained, and occasionally increased by stock dividends or cash returns exceeding 10 per cent. per annum, than that dividends would fall below that rate.

MISFORTUNES OF SOUTHERN RAILWAYS.

While the northern and western railways were enjoying an unusual degree of prosperity a number of southern lines were subjected to great misfortunes. In some instances tracks and rails were torn up by southern armies to be removed to points where they could be more useful for military operations. In various other cases bridges were destroyed and tracks injured as much as possible by northern armies. A considerable number of lines located in or near the scene of active hostilities were made the sport and prey of martial requirements.

Low's Railway Directory for 1865 gives a list of the military railroads of the United States, which, on January 1st, 1865, were under the direction of Brigadier-General D. C. McCallum, director and general manager at Washington. They are classified as follows: *Military Railroads of Virginia*—Alexandria and Washington; Alexandria, Loudon, and Hampshire; Orange and Alexandria; Winchester and Potomac; City Point and Army; Norfolk and Petersburg; Seaboard and Roanoke. *Military Division of the Mississippi*—Nashville and Chattanooga; Nashville, Decatur, and Stevenson; Nashville and North-western; Nashville and Clarksville; Chattanooga and Knoxville; Knoxville and Bristol; Cleveland and Dalton. *Military Division of West Mississippi*—Mobile and Ohio; Memphis and Charleston; Vicksburg and Jackson.

In some cases the seizure and operation of roads by the United States government was presumably more beneficial than injurious, as it insured protection, and after the close of the war enabled the companies to quickly obtain equipment. The greatest injuries inflicted on southern railroads arose from the destruction inflicted by irate armies at various times and places; the collapse of the southern financial system, which in some instances carried with it the loss of valuable assets of southern companies; and the temporary diminution of all classes of peaceful traffic. The combined effect of some or all of these causes is indicated by the following statements of dividends: The Georgia Railroad, which paid 8 per cent. in 1859–60, paid no dividends from that time until 1866–67, when 6½ per cent. was paid. The same rate was maintained in 1867–68, and increased to 8 per cent. in 1868–69. The South-western Railroad, of Georgia, which paid 13 per cent. in 1859–60, paid 4 per cent. in 1865–66; 9 in 1866–67, and 8 in the two closing years of the decade. The Nashville and Chattanooga reported profits of $918,547 in 1862–63, a much larger sum than its profits in any other year of the decade, probably on account of the extensive use of its lines for the movement of troops. Various other railroads, some of which traverse territory that remained under the control of the Confederates until near the close of hostilities, report a large increase in net earnings between 1861 and 1864, followed by a great decline after 1865. The historic South Carolina Railroad, which built and operated the first railway exceeding one hundred miles in the United States, reported dividends of 6 per cent. in 1861, 8 per cent. in 1862, 12 per cent. in 1863, and 16 per cent. in 1864, and no dividends during the remaining years of the decade.

BREAKERS AHEAD.

While the increase of the dividends, and the usual rate of the dividends, of a number of northern and western railways helped to greatly increase public confidence in railway enterprises and to stimulate the organization of new projects, success was by no means universal. The Atlantic and Great Western, built while the war was progressing, which commenced operations with great expectations, was in the hands of receivers before the decade closed. For the year ending June 30th, 1869, its net earnings were reported to be $1,638,078.34, and at that time its capital stock was $30,000,000, and its various classes of indebtedness amounted to $63,897,472.50. Aside from this disastrous showing of one of the most important of the new companies a number of the old lines extensively engaged in competitive movements found, before the decade had closed, that the rate of profit on a given amount of business had wofully decreased, and declines in gross earnings were common. This was one of the most noticeable developments of the period. The Baltimore and Ohio, for instance, reported on gross earnings of $10,138,876 in 1864, a net revenue of $5,692,680, while in 1868 it reported gross earnings of $8,472,218 and $2,692,106 of net revenue. The Philadelphia, Wilmington and Baltimore reported $3,828,464.06 of gross earnings and $1,574,554.39 of net revenue in 1864–65, while in 1868–69 its gross earnings were $2,565,302.31, and its net revenue $874,094.48—the net revenue being in the latter year 34.15 per cent. of the receipts, and in the former 54.29 per cent. The Erie reported in 1863–64 that its gross earnings were $12,551,480, and its net earnings $3,493,726, while in 1868–69 its gross earnings were $16,721,500, and its net earnings were $2,179,395. Some important roads were able to ward off similar changes, by improving their facilities, diminishing the cost of freight movements, and obtaining advantageous new connections or classes of traffic; but in the absence of exceptionally favorable influences, there was a strong tendency towards a marked reduction of railway profits, and some of the companies which did not promptly counteract this tendency either by reducing expenses per ton per mile, or other expedients, were drifting towards a disastrous condition. The roads that had been most materially benefited by new influences, and had failed to provide new sources of profit or to greatly reduce expenses, were the heaviest sufferers, but many lines were adversely affected by the new order of things.

MISCELLANEOUS STATISTICS.

ESTIMATE OF THE MILEAGE AND COST OF AMERICAN RAILROADS IN 1865–66 AND 1869.

IN an early portion of 1866 the American Railroad Journal published the following estimate of the mileage and cost of the railways of each state shortly after the close of the war:—

States.	Mileage. Total, including projected or partly finished lines.	Mileage. Completed.	Cost of road. Total.	Cost of road. Per mile.
Maine	640.59	509.37	$18,134,925	$35,619
New Hampshire	659.33	659.33	22,342,947	33,904
Vermont	596.73	596.73	24,773,417	41,497
Massachusetts	1,353.55	1,309.65	59,956,462	45,999
Rhode Island	151.74	119.24	4,941,240	41,513
Connecticut	717.54	637.54	23,900,001	37,492
New York	3,278.17	2,928.17	145,240,291	49,603
New Jersey	887.80	868.80	49,483,532	56,943
Pennsylvania	4,364.19	3,797.32	195,982,888	51,615
Delaware	172.40	126.90	4,931,709	38,753
Maryland and Dist. of Col.	727.90	486.80	28,558,124	58,641
West Virginia	361.50	361.50	24,370,667	67,508
Kentucky	940.60	613.60	21,639,876	35,244
Ohio	3,999 26	3,392 89	131,872,472	38,865
Michigan	1,734.12	949.32	39,648,812	41,779
Indiana	2,466.50	2,196.07	72,377,489	32,922
Illinois	3,759.65	3,171.25	127,798,081	40,302
Wisconsin	1,357,41	1,044.91	39,580,741	37,876
Minnesota	1,608.00	227.00	8,250,000	36,343
Iowa	2,023.00	946.30	36,142,928	38,206
Missouri	1,572.39	924.75	50,232,482	54,305
Kansas	480.00	122.00	3,500,000	28,699
Nebraska Territory	1,200.00	53.00	3,000,000	56,604
California	1,285.80	262.50	13,800,000	52,671
Oregon	19.50	19.50	500,000	25,641
Virginia	2,054.48	1,378.70	45,146,843	32,739
North Carolina	1,352.42	977.30	19,308,018	19,762
South Carolina	1,072.93	988.93	22,423,690	22,673
Georgia	1,635.23	1,421.22	29,169,513	20,527
Florida	586.50	401.50	8,628,000	21,489
Alabama	1,434.70	891.16	21,351,102	23,979
Mississippi	1,072.12	867.12	24,112,507	27,811
Tennessee	1,392.49	1,317.78	33,977,478	25,779
Arkansas	701.33	38.50	3,800,500	31,169
Louisiana	838.00	335.75	13,627,664	40,559
Texas	2,787.00	451.50	16,509,772	30,607
Total, United States	51,284.87	35,316.40	$1,388,555,268	$38,998
Six New England states	4,119.48	3,831.86	$154,048,992	$40,199
Five middle Atlantic states	9,430.46	8.207.99	424,186,541	51,679
Twelve northern interior states, &c	21,502.43	13,970.59	557,913,148	39,998
Two Pacific states	1,305.30	282.00	14,300,000	50,539
Five southern Atlantic states	6,701.56	5,167.65	124,676,061	24,129
Six gulf and southern interior states	8,225.64	3,901.81	113,428,523	29,064
Total, United States	51,284.87	35,361.40	$1,388,555,268	$38,998

In reference to the method by which the above estimates of cost of roads per mile were obtained the following explanation is given: "In making the reductions to cost per mile in the above table, the aggregate cost in each state has been divided by the completed mileage. This makes a greater or less error in the result, according to the activity of railroad construction in the states severally. Thus in the New England states generally the result obtained by this process is nearly accurate, since the difference between completed and progressing roads is small. In the new states, however, in which large amounts have been expended on roads as yet incomplete the difference is necessarily wider apart."

The census report of 1880 states that the mileage completed at the end of 1865 was 32,995.66.

By the end of 1869 the mileage operated in the United States had increased to 43,510.43, and the aggregate amount of railway stock and bond capital then existing was estimated at about $2,000,000,000, the increase being mainly on account of additions to construction or improvements, but also partly on account of issues of additional capital when consolidations were formed.

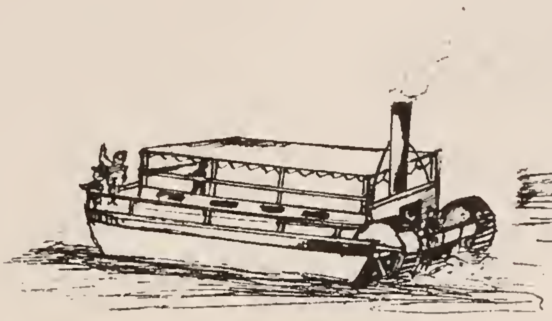
The Railway Journal, in January, 1870, published the following estimate of the mileage and cost of the railways of each state and territory at the end of 1869:—

States, &c.	Miles of road. Total, including unfinished lines.	Miles of road. Open.	Cost of road and equipment.
Maine	940 79	672.07	$21,183,110
New Hampshire	785.32	685.32	22,642,600
Vermont	635.09	613.09	28,784,926
Massachusetts	1,569.75	1,483.70	74,699,443
Rhode Island	121.47	121.47	5,132,672
Connecticut	806.94	698.57	27,359,017
New York	4,735.91	3,636.22	209,001,671
New Jersey	1 023.65	989.65	74,602,735
Pennsylvania	6,878.36	5,014.45	300,556,508
Delaware and East Maryland	455.50	292.50	8,773,637
Maryland (other than above)	730.02	493.52	31,814,659
West Virginia	723.75	364.75	27,869,315
Virginia	2,049.11	1,482.94	49,887,481
North Carolina	1,552.97	1,129.67	29,505,425
South Carolina	1,439.17	1,089.97	27,348,817
Georgia	2,095.41	1,694.70	36,875,552
Florida	613.20	440.20	9,883,981
Alabama	2,039.80	1,036.00	36,421,163
Mississippi	900.20	900.20	24,910,504
Louisiana	928.30	414.50	17 385,223
Texas	2,529.25	572.25	17,006,000
Arkansas	897.00	86.00	4,310,000
Tennessee	1,876.53	1,435.53	46,918,448
Kentucky	1,402.85	849.55	33,511,746
Ohio	4,613.96	3,723.89	100,424,507
Michigan	2,293.26	1,198.76	48,793,418
Indiana	5,331.10	2,977.10	121,162,301
Illinois	7,186.45	4,707.95	217,559,542
Wisconsin	2,779.60	1,490.60	60,358,723
Minnesota	1,800.00	823.00	27,160,000
Iowa	3,219.28	2,140.83	85,762,043
Nebraska	449.00	449.00	26,450,000
Wyoming Territory	560.00	560.00	43,300,000
Missouri	3,261.79	1,827.00	88,372,121
Kansas	1,601.50	930.50	39,623,500
Colorado	350.00	150.00	6,000,000
Utah Territory	365.00	365.00	18,000,000
Nevada	390.00	390.00	19,500,000
California	2,397.60	810.60	46,650,000
Oregon	2,019.50	119.50	5,700,000
Total, January 1st, 1870	76,366.38	48,860.55	$2,212,412,719

RELATIVE RANK OF RAILWAYS AMONG TRANSPORTATION AGENCIES.

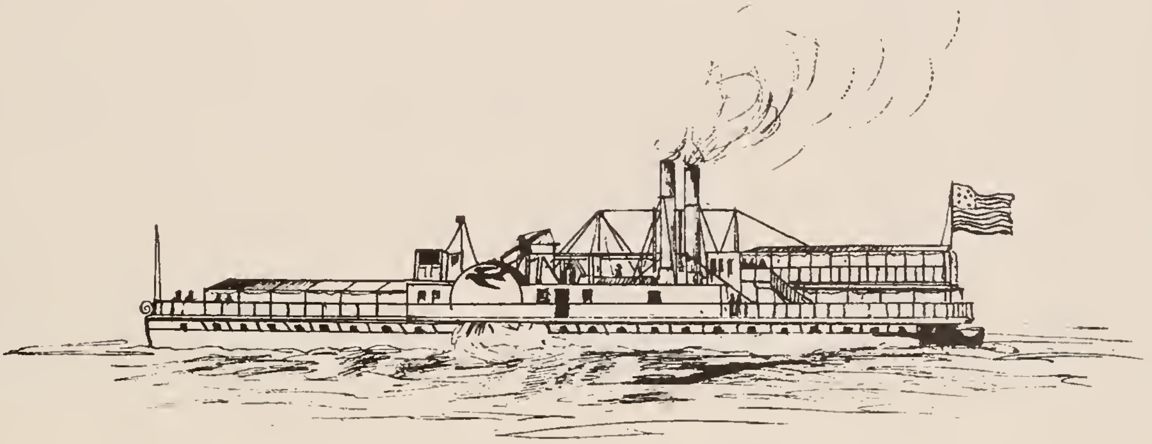
Reference has heretofore been made to the low relative rank of railways, in comparison with canals, steamboats, and stage-coach movements in 1840, and to the rapid forward strides made by railways from 1840 to 1850. An indication of the extent of the enormous subsequent progress of the railways from 1850 to 1867 is furnished by a United States government report for the year ending June 30th, 1867, in tables exhibiting the internal revenue for that period on the gross receipts of canals, railroads, ships, barges, &c., stage-coaches and steamboats, the rate of taxation on each of these agencies being 2½ per cent. The aggregates were as follows: Canals, $45,282.40; railroads, $4,128,255.24; ships, barges, &c., $4,876.54; stage-coaches, $241,297.09; steamboats, $91,805.09.

The taxes levied on railroad companies may have been more uniformly collected than those imposed on the other classes named, but after due allowance is made for such a circumstance, it is evident that the railways, in amount of business and gross receipts, greatly exceeded all the other agencies

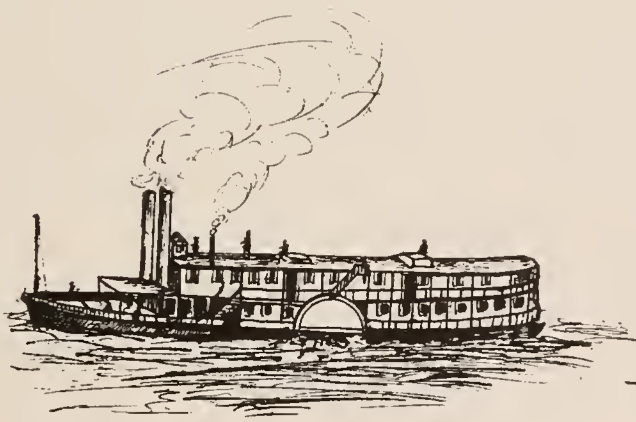


Small Steamboat Running on the Schuylkill in 1824.

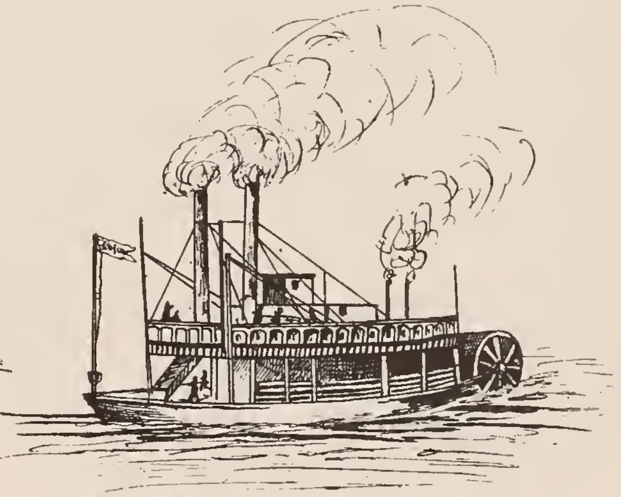
Steamboat with Safety Barge attached, running on the Hudson in 1826.



Fast Steamboat Plying on the Hudson in 1837.



Western River Steamboat Running in 1837.



Western River Stern Wheel Boat.

combined, as the amount of tax paid by all of them only slightly exceeds one-tenth of the sum paid by the railways, and it falls below the tax paid by the express companies, which made nearly all their lengthy movements over railway lines during the same year. This tax was at the rate of 3 per cent., and amounted to $558,359.28. Other internal revenue taxes were imposed at the rate of 3 per cent. on the gross receipts of bridges and toll roads, from which source a revenue of $115,461.20 was derived, and on ferries, which yielded a revenue of $137,239.72.

A relation similar to that mentioned above existed in other years in which taxation was imposed on gross receipts, as will be seen by the following statement of internal revenue collections of the fiscal years of 1865 and 1866:—

	1865.	1866.
Bridges and toll roads	$75,268 95	$108,136 34
Canals	92,421 29	99,267 80
Express companies	529,275 89	645,769 02
Ferries	126,132 57	48,763 56
Railroads	5,917,293 51	7,614,448 13
Ships, barges, &c	431,210 58	39,321 79
Stage-coaches, wagons, &c	469,187 56	572,519 04
Steamboats	638,812 28	84,845 99

An interesting indication of the extent to which railways had supplanted other agencies in the various states and territories, is shown by the following table of the internal revenue paid in each of the states, on the gross receipts of the companies or interests named, during the fiscal year ended June 30th, 1867:—

States, &c.	Canals, 2½ p. ct.	Railroads, 2½ p. ct.	Ships, barges, &c., 2½ p. ct.	Stage-coaches, 2½ p. ct.	Steam-boats, 2½ p. ct.
Alabama	......	$61,2-5 98	....	$804 81	$98 83
Arizona	......	......	......	......	......
Arkansas	......	538 91	$24 00	245 52	......
California	$13,142 41	56,939 88	409 83	45,569 64	......
Colorado	185 68	......	......	737 33	......
Connecticut	......	97,516 28	......	886 03	573 04
Dakota	......	......	......	......	......
Delaware	......	551 04	387 33	284 11	7 50
Dis. of Col	......	9,209 61	......	703 52	1,921 89
Florida	......	8,542 12	422 38	759 04	252 23
Georgia	328 95	89,763 40	416 17	1,605 06	1,960 45
Idaho	4,003 05	......	......	5,255 18	......
Illinois	......	370,367 06	......	6,017 89	......
Indiana	......	101,468 39	610 22	1,295 01	274 64
Iowa	......	28,217 26	......	7,021 98	......
Kansas	......	13,532 38	......	17,370 09	717 82
Kentucky	3,275 89	52,666 81	......	6,771 04	147 84
Louisiana	2,515 85	63,650 98	138 28	1,253 91	672 23
Maine	19 33	39,675 27	40 52	3,123 99	3,623 68
Maryland	......	135,177 34	284 30	4,844 75	212 98
Massachusetts	......	283,372 69	129 22	9,025 39	2,066 17
Michigan	......	101,766 17	307 18	6,407 21	245 32
Minnesota	......	18,980 74	......	3,770 09	......
Mississippi	......	10 83	......	207 24	691 34
Missouri	......	98,778 63	29 25	5,434 85	16,359 88
Montana	1,200 46	......	......	3,402 13	......
Nebraska	......	2,858 44	......	1,301 72	......
Nevada	2,614 93	.....	......	3,332 83	......
N. Hampshire	......	58,625 50	70 00	3,906 66	17 07
New Jersey	7,756 00	307,447 68	89 71	2,656 71	630 60
New Mexico	......	......	......	3,739 69	......
New York	406 09	632,571 55	785 27	48,462 84	21,231 66
North Carolina	......	36,946 90	......	196 71	684 55
Ohio	......	407,876 33	45 34	6,507 02	10,313 33
Oregon	1,219 38	1,488 87	......	8,682 88	7,959 16
Pennsylvania	3,436 59	749,402 91	148 03	9,946 17	4,295 81
Rhode Island	......	18,832 21	......	1,343 36	8,954 01
South Carolina	......	20,096 50	77 14	224 83	1,167 70
Tennessee	......	88,167 95	......	912 77	17 18
Texas	......	21,885 40	......	5,701 07	1,616 06
Utah	......	......	24 02	800 91	......
Vermont	......	36,333 69	.... .	798 08	2,164 36
Virginia	5,177 79	45,659 07	106 39	2,462 53	138 59
Washington	......	401 12	......	3,898 99	1 98
West Virginia	......	......	161 41	1,129 59	869 55
Wisconsin	......	62,649 35	170 55	2,495 92	1,917 64
Total	$45,282 40	$4,128,255 24	$4,876 54	$241,297 09	$91,805 09

CONSOLIDATION OF CONNECTING LINES.

THE work of consolidating connecting lines had been fairly commenced in some sections before 1860. Two of the most important were made by the consolidation of the numerous companies which originally built the railways now forming the main line of the New York Central in 1853, and by the purchase of state works of Pennsylvania, and the leasing of a short railway between Harrisburg and Lancaster, which gave to the Pennsylvania Railroad a continuous line between Philadelphia and Pittsburgh. In view of the fact that the Baltimore and Ohio and Erie were each built and operated by a single company, and designed from the outset to serve as important channels of through traffic, it is obvious that the consolidations which created the New York Central, and the purchase and lease which secured to the Pennsylvania Railroad Company the control of a continuous line between the two leading cities of the state it traversed, were necessary to enable them to hopefully contend with their two American trunk-line rivals in the competition for through traffic which speedily commenced. Various other consolidations, scarcely less necessary to the prosperity of the companies affected, were made during the sixth decade, such as the union of the Lebanon Valley and various short coal roads with the Reading; the union of lines which formed the Pittsburgh, Fort Wayne and Chicago; the combinations of various lines in Illinois, and a number of combinations in other states. As a rule, however, the prevailing practice before 1860, in most sections, continued to be favorable to the maintenance of the independence of each company, except in special cases, where there were unusually good reasons for the adoption of a different policy; while after 1860 a number of important consolidations were made, and during the seventh decade they became so numerous that they formed a leading feature of the developments of that period.

THE PENNSYLVANIA RAILROAD

engaged more extensively in such operations than any other company. From the beginning made by the construction of a line between Harrisburg and Pittsburgh, a distance of 249 miles, and the purchase of state works, it had, before the close of the seventh decade, secured by construction, purchase, and leases, the control of 2,458.5 miles of railway, including its main line and branches; the Philadelphia and Erie, 287.5 miles; the Pittsburgh, Fort Wayne and Chicago, 468 miles, and other roads west of Pittsburgh, with an aggregate length of 1,111.6 miles, viz., Pittsburgh, Cincinnati and St. Louis, 200.5; Little Miami, Columbus and Xenia, 196.6; Columbus, Chicago and Indiana Central, 600.5, and Indianapolis and Vincennes, 114. It had also secured, by obtaining a controlling interest in the Northern Central, good facilities for reaching Baltimore, and relatively convenient connections with New York by the Allentown route, leading from Harrisburg eastward, via the Reading and Jersey Central. At an early period in the eighth decade it also leased the lines of the United Companies of New Jersey, thus giving a direct entrance into Jersey City, and control of much valuable railway and canal mileage.

Next in importance were the consolidations or leases made by the

NEW YORK CENTRAL AND HUDSON RIVER.

During the sixth decade it had combined the short lines that in the aggregate made a connecting link between Buffalo and Albany, and during the seventh decade this construction was supplemented by a consolidation with the Hudson River Railroad, leading to the city of New York. This union, and the leased roads controlled by it, made the mileage of the main line represented by the New York Central and Hudson River after October 1st, 1869, 842.21. Cornelius Vanderbilt became the head of the system. He had previously been actively identified for some years with the Hudson River and Harlem roads, leading from New York to Albany (but not with the New York Central); and about or soon after that period he became prominently connected with important western railroads under conditions which practically secured for the New York Central connections west of Buffalo analogous in importance to those obtained by the Pennsylvania through its lease of the Pittsburgh, Fort Wayne and Chicago and the Pittsburgh, Cincinnati and St. Louis. In 1869 a consolidation was made of the Lake Shore, Michigan Southern, and various shorter lines forming a through rail connection between Buffalo and Chicago, and of various branches and laterals, having a total length of 945.15 miles. And of this consolidated company, Horace F. Clark, a son-in-law of Commodore Vanderbilt, was president.

THE ERIE RAILROAD,

which had originally built a line 459 miles in length between Jersey City and Dunkirk, had purchased or leased branches 386.75 miles in length, making an aggregate of 845.75 miles; and in addition, it was in 1869, under a lease of the Atlantic and Great Western, operating or moving trains over 565.81 miles; and it was also moving trains over 34.25 miles of short New York roads,—making the total mileage operated directly, or partially by the Erie, 1,355.08.

OTHER IMPORTANT CONSOLIDATIONS.

In addition to these important extensions of trunk-line systems, a number of other extensions, consolidations, or leases were made during the seventh decade, including the following: The Philadelphia and Reading which, in 1862, had 261.13 miles of main line and 176.32 of branch lines, a total of 437.45, had, in 1869, 326 miles of main line and 815 miles of branch lines, or sidings and laterals, a total of 1,141.90. The other anthracite railways had made considerable additions to the mileage owned or operated. Leading western and north-western railroads had greatly increased their mileage, either by leases or new construction. The Chicago and Rock Island, which had 228.4 miles open in 1860–61, operated 590.5 miles in 1868–69. The Chicago and North-western was in 1869 operating 1,282 miles. The Chicago, Burlington and Quincy, which in 1863–64 was operating 264 miles, was operating 602.25 before the end of 1869. The mileage of the Milwaukee and St. Paul had on May 1st, 1870, been increased by consolidation to 938.

THE GENERAL SUBJECT OF RAILWAY CONSOLIDATIONS

has frequently attracted much attention, and the combinations effected at various times have exercised a marked influence upon the companies concerned and the public. The circumstances of each particular transaction cannot be described within brief limits, but they should be studied and understood by those who wish to reach a just conclusion in regard to the terms of either of the numerous compacts made. Such an elaborate inquiry might result in a belief that bad bargains were made by large roads in some instances, and by small roads in others, but the owners of the securities of the short lines have in a majority of instances probably been materially benefited by the protection and security derived from an alliance with longer lines, if they remained solvent. Much of the most desirable railway property of the country is now represented by the bonds and stocks of companies whose roads are leased and operated by more powerful organizations. It seems unquestionable that

PUBLIC INTERESTS HAVE BEEN PROMOTED

to an extraordinary extent, in various ways, by the process of consolidation, especially in the improvement of facilities for the cheap, rapid, and convenient movement of passengers and freight between distant points, the avoidance of delays and changes of cars, the reduction of freight charges, and the increase of the responsibility of carriers.

There is a vast difference between traveling or transporting freight over a distance of say one thousand miles, under a railway system made up of loose combinations of twenty companies, each having lines of an average length of fifty miles, on the one hand, and of making corresponding movements over the same aggregation of lines after they are practically under the control of a single vigorous and progressive company. The twenty organizations might have twenty sets of passenger or freight cars and changes, requiring the movement of passengers at the end of each of their respective lines, and analogous changes of freight might also be required. Supposing the number of such changes to be materially reduced, as they frequently were, in connection with movements over routes formed by a combination of short lines, there was always more or less of a lack of certainty, completeness, or permanency about such combinations. There might be relatively good arrangements during one season which would be less satisfactory in another. The condition of the road-bed or locomotives on some parts of the line would often be much better than on others. Mechanical advances desired by some of the companies, would not or could not be promptly provided by all their associates.

In addition to all such difficulties serious questions sometimes arose about responsibility for losses or damages to freight, and if a company controlling a portion of the combined route happened to be bankrupt, speedy payments for losses or injuries inflicted while movements were being made over its line could not be secured. Twenty managements, having a legal right to act independently or diversely on many subjects, could scarcely exist without occasionally displaying antagonistic proclivities which would thwart the completeness of through freight or passenger connections.

Consolidations of considerable consequence were probably made in England before they were attempted here, and one of the results was a remarkable increase in the amount of the traffic of all the lines united. This is as natural as that more trade should originate on a large lake than on a small one, or that there should be more steamboats plying on a lengthy navigable river than on a short one. The circle of commerce is widened by every step that removes barriers between producers and consumers, by reducing the cost of movements and diminishing other obstructions to free intercourse. Railways accomplish such ends even more rapidly and effectively than ordinary internal water courses, inasmuch as their operations are usually conducted with a degree of regularity and celerity never attained by other agencies. Long railways, or combinations of a number of short lines under conditions which practically convert them into compact and reliable systems, are enabled, by concentrations, to materially increase their usefulness to all interests and communities they serve.

The Massachusetts railroad commissioners, in their report for 1873, drew the following conclusions, after an examination of the experience of Great Britain, which may fairly be taken as an illustration of a general law: "The evidence seems to be almost conclusive that positive benefit rather than injury has there resulted from amalgamation, so far as it has gone. Not only have the evils anticipated not resulted, but it would seem that the public has invariably been better and more economically served by the consolidated than by the independent companies. The larger companies employ abler officers, and seem to be managed more on the system of great departments of commerce, and less on that of lines of stage-coaches. The time and attention of the officers are not mainly absorbed in questions of corporate hostility, and the money of the companies is wasted in a somewhat less degree in warfare with each other. There is, in fact, far less of friction in the work of transportation, and far more of system. Finally, as regards the community at large, it is found that large companies can be held to a closer responsibility than small ones. Their prominence enables public opinion to concentrate upon them. They are more closely watched, and held to a stricter account."

Mr. C. F. Adams says: "The clearer political observers have come to realize at last that concentration brings with it an increased sense of responsibility. The larger the railroad corporation, the more cautious is its policy. As a result, therefore, of forty years of experiment and agitation, Great Britain has on this head come back very nearly to its point of commencement."

In commenting upon the favorable results of railway consolidation in Great Britain, the chief of the bureau of statistics, in his report upon the internal commerce of the United States for 1881, says: "A similar result has followed railroad consolidation in the United States. It has, heretofore, been shown that the average of all the rates charged on fifteen leading railroads of the country, including those of the great east and west trunk lines, and the principal railroads west of the Allegheny mountains, engaged in traffic between the western and northwestern states and the Atlantic seaboard, has decreased 39.45 per cent. since 1870, this reduction in railroad freight charges having been more than three times as great as the average reduction during the same period in the prices of twenty-two of the leading articles of commerce."

EFFECT OF CONSOLIDATIONS ON POWER TO DO GOOD OR EVIL.

A graphic description of the benefits derived by the public from consolidations is contained in the following statements made by Mr. Edwin D. Worcester, secretary of the New York Central, before the Senate committee on transportation routes to the seaboard, in 1873:—

"All the permanent and progressive reduction of rates that I have spoken of, and the whole practical efficiency of the entire railroad system, have been due entirely to consolidation or to the concentration of lines originally distinct. . . . We had ten roads between Albany and Buffalo. There was just about as much efficiency in operating ten roads as there would be in ten men trying to do a thing that one ought to do. Every board of directors had its own profit to make, and its own schemes to advance. There was no obligation on the part of any one company to do anything for any other. Through lines of cars could be run only by very complicated and embarrassing arrangements. I can remember the time when conductors were changed at the end of each one of the roads of the old line between Buffalo and Albany. In some cases a ticket could not be bought through from Albany to Buffalo. The elements of usefulness and economy were very few. In regard to freight, there was no obligation on the part of any one of the roads to take a single pound of it from another. Except so far as they might choose to agree with each other, it involved changing at each terminus. The policy of consolidation was what first led to the prorating of freight charges. They are now prorated, where the old number of lines could never have been got into any agreement. Other companies, too, have been carrying on this system of consolidations. All the railroads in France have been combined into four systems. In England substantially all the railroads have been absorbed into five or six general systems. . . . If there is any principle involved in having no railroad in single control exceed, say, one hundred miles in length, the same general rule might just as well limit to a single mile. The objection that is frequently urged to consolidation is the so-called great power created. There seems to be a frightful idea that any power that may be exercised for good may be exercised for evil. In limiting the simple exercise of power so as to surely insure against the possibility of doing evil, it is very easy to defeat the ability to do good. What is the really proper course to take when an absolute advantage is considered as against a remote contingency of disadvantage, or as against mere possibility, is quite easy to determine. In ordinary matters there is never any difficulty. . . . There is, however, no good reason for supposing that consolidation does really increase power. For all the purposes of practical power to accomplish the terrible purposes so much feared, there would be a great deal more ability in the separate companies than in the combined company. The combined company is, at least, answerable as a unit, and the absence of moral responsibility that is supposed to exist, because by reason of an aggregation of parties it is so divided that no one, as it is said, is responsible, would be vastly increased if such unit were divided into the fractions from which it was formed. Each fraction in this case would have the full effect of the whole unit."

In another portion of Mr. Worcester's testimony he said, "There are some features attending the transhipment or transfer of property under the old-fashioned way of doing business. I was in the mercantile business a good many years ago, before railroads came into use for freight purposes. One of my duties was to mark goods to be shipped, and I well remember marking to the care of three or four people. For instance, going by canal, care of such a man at Buffalo, care of some one else at some point up the lake; some one else at some interior point, and so on. In the then ordinary way of doing business, a man shipped his property to a certain point, say the terminal of some route, and when he got there it was subject to his order: If he was not there himself, he had an agent or consignee to take it. The business of that agent or consignee would be to pay the charges if not prepaid when the property was shipped, deliver it to the next party in the line of transportation after making his bargain with such party, and so on, for every point of shipment. The same rule would, abstractly considered, apply to-day, but all this detail is done voluntarily by the railroad companies for the convenience of shippers and the public. Property shipped from Chicago, St. Louis, and even San Francisco, comes to New York without any special oversight or charge. If from Canada we even enter it at the custom house, and give a bond for duties. This is all voluntary. Few people have any conception of the vast amount of troublesome business done by railroad companies for them in this way, and *yet the saving of the expense of transfer or reshipment, instead of being made the source of additional profit, has been applied to the reduction of rates.*"

DENUNCIATIONS OF COMPANIES

which are based on the mere fact that their operations extend over a large area and are conducted on a gigantic scale are not justified by actual developments. Great companies, like little ones, may fail to conduct some of their operations in a satisfactory manner; but the chances of obtaining reliable service on a lengthy route are usually much better if it is rendered by one company, than if a passenger or shipper is obliged to depend upon numerous independent organizations.

All this is now so well understood by those who have practically tested different methods, that the question of greatest importance is whether the gigantic companies will be enabled to bear the burden of the obligations they have assumed. Different solutions will presumably be reached in different cases, hereafter, as they have been reached, heretofore, the particular results depending largely upon the nature of the compacts made in each instance. Consolidation, in itself, has conferred many benefits, and it would be difficult to point out any positive injuries, except those suffered in some instances by stockholders or creditors, whose interests were adversely affected by unjust or unfortunate bargains, or by the facilities which gigantic combinations afforded for ruinous rate-cutting on a stupendous scale. It may be laid down as a rule, however, that there is a special necessity for careful safeguards against consolidating under any single management more mileage than it can effectively manage.

FINANCIAL EFFECTS OF CONSOLIDATIONS.

The disposition to consolidate many roads into large systems, which rapidly increased during the seventh decade, made a material addition to the opportunities for converting relatively short new lines or old ones into sources of profit, as they could be offered to rival large corporations, and in some instances disposed of on very advantageous terms, and the practice was adopted in some of the consolidations of making issues of new stock for the purpose of equalizing the values of the respective properties combined.

Much has been said, at various times, of the effect of these new stock issues in increasing railway capital. So far as the interests of the general public are concerned, they have rarely exercised any influence whatever, as few, if any, of the lengthy railroads engaged in competitive operations are enabled to make any advance in charges on account of an increase of amount of capital stock. If the supposition that practical operations on a railway have any connection with the amount of its capital stock has any foundation, it must be based chiefly on the doings of comparatively small lines or lines that are not subjected to the sharp competitive influences which now prevail, almost universally, in connection with nearly all classes of local and through traffic. Certain it is that a number of lines which are supposed to have issued a specially large amount of capital stock have rarely been able to earn dividends on such capital, and it is palpable that earning power, as a rule, does not depend upon, and is not governed or materially affected by, the amount of capital stock. The question may still be asked, however, why did various lines, when consolidating, make the nominal amount of their capital stock differ from the sum it represented previous to such consolidation? There would be a considerable difference in answers given in different cases.

If it is supposed that two roads, which each had a capital stock amounting to $1,000,000, after maintaining an independent existence for a number of years, had agreed to consolidate, and to substitute for their old certificates new ones, nothing would be more natural than that the aggregate amount of the new issue, and the proportion of it to be assigned to the shareholders of each of the old companies, should receive very serious consideration, and be finally determined by various influences. One might be the market value at the time of the consolidation, and if the shares of one of the companies were at a premium and the shares of the other at a discount, it is obvious that the new stock would probably not be apportioned without due regard for this important distinction. If the shares of both companies had risen in market value above the par value, and if the profits of the companies had been sufficient to maintain the shares at such advanced quotations during a protracted period, the new stock representing the consolidated interests would be more likely to represent the market value than the par value. Then there was a possibility that the mere act of consolidation would increase the earning power of each of the consolidating companies, and this increase may have been sometimes represented in the new stock issue. There were numerous cases, too, in which companies, instead of dividing their net earnings among shareholders, had applied an unusually large proportion to permanent improvements, and for this temporary privation a corresponding equivalent in an increased amount of the new consolidated stock might be demanded. There were other cases in which a comparatively short road was absorbed by a long one, and the circumstances were such that its shareholders demanded that they should be guaranteed a high rate of dividends—say 12 per cent., and it was deemed prudent to have this rate practically represented by a large issue of capital, drawing—say 7 per cent.; as this expedient would probably help to evade legislation relating to the rate of railway dividends.

Independent of all legitimate considerations, a field for speculative financiering was opened by some of the consolidations. With the best of intentions, and the most earnest desire on the part of all concerned to have the new stock of a consolidated system fixed and distributed on entirely equitable principles, great changes in the earning value of particular properties might speedily show that excessive estimates had been made; and as it may be assumed that the best of intentions did not always prevail in the arrangement of such affairs, existing contrasts between the earning value and the capitalization of portions of some of the consolidated systems are not surprising.

EFFECTS OF CONSOLIDATIONS OF RIVAL LINES IN PREVENTING COMPETITION.

The famous maxim of Robert Stephenson that "railway competition is not possible where consolidation is practicable" is generally verified, sooner or later, in cases where a few comparatively short parallel lines compete for all the through and local traffic of a given region, and it is in such cases, particularly, that the evil effects of building two railways to do the work of one are felt, by the company that survives a competitive death struggle, the company that is ruined, and the community served. A remarkable illustration of the results of such contests, which has found partial or complete counterparts in a number of instances, and notably in the case of the West Shore and New York Central, is furnished in a letter of Isaac Hinckley, president of the Philadelphia, Wilmington and Baltimore, dated February 23d, 1874, to the Senate committee on transportation routes to the seaboard, which says: "Lowell, Massachusetts, 26 miles from Boston, was connected with that city by the Boston and Lowell Railroad, of which I was a director for fifteen years. We were, in or about 1854, carrying passengers at 60 cents, coal at 75 cents, and other freights in proportion. The Salem and Lowell Railroad about that time commenced, in connection with the Boston and Maine Railroad, to compete for trade. Passenger rates went to 45 cents, and coal to 50 cents generally, and once to 30 cents. These rates were injurious to the Boston and Lowell, and insupportable by the Salem and Lowell. Compromise and lease followed. Passenger rates went to 75 cents, then to $1, and now are 75 cents. Coal rates went to $1.25 at once, and subsequently to $1.75; since reduced, I think, to $1.25. Other rates were affected in the same direction, yet the Boston and Lowell Railroad Company, who took the lease, fared no better than it did with low rates before the Salem and Lowell was built."

Mr. Hinckley wisely drew a broad distinction between the ease with which competition could be checked on comparatively short parallel lines and the difficulty of arresting it on long through routes. He said: "In here speaking of competition I do not refer to cases where the business competed for is but a portion of the business of the road, and, therefore, is not of prime consideration. Thus the great trunk lines may go on competing indefinitely for the western and seaboard traffic, because such competition is not destructively exhaustive, in view of the large local traffic which those lines enjoy free from competition. Yet even here the public frequently suffers, as, for instance, when competition has reduced the rates to cost, or even below cost, and the railroad companies, in self-preservation, agree together for a time, forming what we may call a temporary consolidation, under which rates are spasmodically raised."

It is to be remembered that the famous Stephenson maxim relating to the cessation of railway competition only applies to cases "where consolidation is practicable," and while it does apply to them with considerable regularity, there are many forms of railway competition in this country which never have been, and from the nature of the organizations concerned, probably never will be, arrested by permanent consolidations. This remark is applicable to all the great through-route systems, whether they pertain to movements between the Atlantic coasts and the Mississippi valley, or between western traffic centres and adjacent agricultural districts, or between the Pacific coast and the Mississippi valley. In reality these lines have always been competing with each other for through traffic, since they were in a physical and financial condition to make such competition effective, even during the brief periods when agreed rates and all requirements of pooling arrangements were most faithfully maintained. The real mission of pooling arrangements is not to avert competition, for that is impossible while diverse permanent financial interests exist, but to diminish the evils of unrestrained competition, and to afford incidental protection to the local interests and industries which are adversely affected by a ruinous lowering of through rates.

CONNECTION OF RAILWAYS AT TRAFFIC CENTRES.

Another notable tendency, which, although it did not involve a consolidation of business interests, had an effect analogous to consolidation in improving the arrangements for through movements, and which had been checked at a number of traffic centres until after 1860, and then extensively adopted between 1860 and 1870, was towards the construction of tracks over which connections could be made with locomotive power, of passenger or freight trains, between the leading metropolitan stations of different railways. At some points the construction of union depots or stations formed part of this movement. At others it did not. There were cities in which the principle of effective union for the interchange of all classes of traffic was carried out to the fullest extent, and others in which there were important reservations. But, generally speaking, the movement towards materially increasing the facilities for forwarding passengers and freight from one railway terminus to other adjacent termini in the same city was nearly universal. It was of sufficient consequence to constitute an epoch in railway development, and was stimulated or hastened by events and requirements of the war, such as the movement of large bodies of troops, or many sick and wounded soldiers, through cities, and the additional necessity created for rapid passenger and freight movements of various kinds. While the issue of union or disunion was being debated at the cannon's mouth, one of the most imperative of the military and political requirements in each section was the improvement of means of transportation in all practical ways, including the sweeping away of municipal obstacles; and although each army aimed at crippling or diminishing the facilities possessed by its adversary, a constant pressure was exerted in favor of the removal of artificial obstructions, such as those arising from attempts to prevent a convenient interchange of the traffic of the lines radiating from important business centres.

A notable illustration of the tendencies referred to is furnished by the construction of the Connecting Railroad in Philadelphia, by which a direct connection was secured between the Philadelphia and Trenton road leading to Jersey City, and the main line of the Pennsylvania Railroad, and (via the Junction) with the Philadelphia, Wilmington and Baltimore on the south.

When the act incorporating the Connecting road was passed in 1863, the United States Railroad and Mining Register said: "At the same time that the Connecting Railroad thus fortifies and accommodates Philadelphia with reference to the western trade, it likewise carries to Philadelphia the facilities and conveniences incident to the main line of communication between New York and Washington, as against the rail route between New York and Washington via Reading and Columbia."

The following reference to the Connecting Railroad, in the Pennsylvania Railroad report for 1864, dated February 18th, 1865, also directs attention to the importance of that line as an adjunct in the attempt to use the main line of the Pennsylvania Railroad east of Harrisburg, instead of the Lebanon Valley and Allentown line, in conducting traffic between New York and the west:—

"The construction of the Connecting Railway, chartered to join the Pennsylvania Railway in West Philadelphia with the Philadelphia and Trenton road at Frankford, a distance of seven miles, has been commenced, and will be pushed to completion as rapidly as circumstances will permit. The right of way, one of the chief elements of its cost, has been mostly secured. This connection will bring the line from New York to Harrisburg and the west, via Philadelphia, within twelve miles of the same distance as via Allentown, and will doubtless return to this end of our road much of the travel which the delays and obstructions in passing through this city has driven to other channels."

The changes that occurred at Philadelphia on account of the construction of the Connecting Railroad were of sufficient importance to leave a deep impress on many ramifications of railway policy which there is not space to discuss here. Analogous movements were made in various other quarters, partly on account of the pressure of war influences, which favored the establishment of the closest possible relations between various sections, and partly on account of a strong disposition, in cases where cities continued to interpose unnecessary obstacles to convenient railway movements through their boundaries, to devise routes by which their territory could be avoided.

UNION DEPOTS OR STATIONS.

One of the places at which a main depot (or station) was established was Erie. It was constructed in 1865, to be used, partly, by the Cleveland and Erie; Buffalo and Erie; Philadelphia and Erie; and Erie and Pittsburgh. A contemporary description says "the building is of brick, in Romanesque style of architecture, and running east and west between the Lake Shore and Philadelphia and Erie railroad tracks. Including the covered platforms—which are in some respects the most useful portion of the building—the depot is 475 feet long by 81 feet in width, two stories high for some distance from its front, and surmounted in the centre by a neat cupola, to be some 40 feet in height."

There were also several Union depots at Chicago, one of which was constructed for the joint use of the Michigan Southern and Chicago and Rock Island about 1866. It occupied a square of ground, and was five hundred and fifty-two feet long and one hundred and sixty feet wide.

At Toledo the Toledo, Wabash and Western used the passenger station of the Michigan Southern, which was a large and commodious structure, built of brick, four hundred and eighty feet long and sixty feet wide.

Similar arrangements were made at various other points.

OPERATIONS OF THE TRUNK LINES.

PARTICULAR interest was felt during the latter part of the seventh decade in the operations of the trunk lines, and especially the Pennsylvania, New York Central and Hudson River, and the Erie. At that time John Edgar Thomson was president and Thomas A. Scott first vice-president of the Pennsylvania; Cornelius Vanderbilt was president of the New York Central and Hudson River; Jay Gould was president and James Fisk, jr., vice-president of the Erie; and John W. Garrett was president of the Baltimore and Ohio. Reference has already been made to the important additions to the mileage of most of these lines during the decade, and there was even a greater increase in the amount of business transacted, of capital, and of the energy with which competitive struggles for through east and west-bound traffic was conducted. Financial and business circles were not unfrequently treated to startling surprises by the magnitude of new enterprises undertaken, or the methods by which one of the rival organizations antagonized another. A large portion of the exciting railway incidents of the period hinged on the doings of these lines and their active managers. The nature of some of these events is indicated by statements made in annual reports. The increase of capital was as follows: On the Pennsylvania, main line and branches, the stock and debt were $31,025,271 in 1860, $36,584,840 in 1865, and $66,610,090 in 1870. On the Erie it was $40,076,620 in 1860, $43,467,378 in 1865, and $106,935,710 in 1870. On the New York Central it was $51,502,601 in 1860, $53,544,533 in 1865, and $103,110,137 in 1870. Other operations are shown in the following table:—

	Gross earnings.	Net earnings.	Tons of freight moved one mile.	Earnings per ton per mile, cents.	Net earn'gs per ton per mile, cents.
N. Y. Cent. in 1860.	$8,043,484	$3,456,520	239,418,931	2.065	0.722
" " 1865.	18,427,904	3,689,382	318,732,070	3.451	0.913
" " 1870.	22,363,320	8,295,240	769,087,777	1.853	0.710
Erie in 1860........	5,180,322	1,903,326	214,084,396	1.814	0.813
" 1865........	15,300,575	4,483,385	388,557,213	2.76	0.77
" 1870........	16,179,461	4,106,450	898,862,718	1.333	0.358
Pennsylv'a in 1860..	5,932,701	2,296,402	214,162,018	1.957	0.781
" " 1865..	17,459,169	4,189,111	420,060,260	2.665	0.384
" " 1870..	17,531,707	6,271,622	825,979,692	1.549	0.551

The vicissitudes of these lines, with alternate periods of peace and war, of prosperity and adversity, represent many of the most striking phases of American railway history. Fortunately for all concerned, they each possess a large amount of local traffic, which furnishes a reliable revenue, and has only been affected in a moderate degree by numerous through-rate wars. But they have also been, in conjunction with the Baltimore and Ohio, the leading railway avenues over which the principal passenger and freight movements between the Mississippi valley and the Atlantic seaboard, in the United States, since an early part of the sixth decade, have been conducted, and as a very large proportion of this through business has been competitive, each of the four lines struggling to obtain the largest attainable share of it, the general result of their efforts has been to develop the most effective and economical system of practical railway operation. Labors of other

American roads have done much to contribute to the same result, but nowhere else have the incentives to unremitting efforts to increase the speed and comfort of passenger movements, and to reduce the cost of freight movements, been so powerful. The necessity of a resort to every expedient available for the accomplishment of such objects was keenly felt during the closing years of the seventh decade, and many methods for promoting them were applied during that period, but all that was then done, in view of subsequent developments, may now be regarded as only a very vigorous commencement of the task of improving and cheapening railway transportation.

RELATIVE IMPORTANCE OF THROUGH MOVEMENTS DURING THE SEVENTH DECADE.

While there have been severe and injurious struggles for through-rail traffic ever since routes over which it could be carried have been opened, and while the amount of both through and local traffic have enormously increased since the seventh decade, the relative importance of through traffic, as well as the amount of profit it yielded, was formerly much greater than it is at present, or has been in any recent year. In other words, the local traffic of the trunk lines, as represented by ton-mileage, increased much more rapidly than through traffic, and the through traffic formerly represented a much larger proportion of the entire amount of railway labor performed than at the present time.

An illustration of this fact is furnished by the freight movements on the Pennsylvania Railroad during 1864, which were as follows:—

	Ton mileage.
322,497 tons of through freight went eastward	115,453,989
147,972 tons of through freight went westward	52,974,629
1,482,647 tons of local freight went eastward	200,041,352
632,263 tons of local freight went westward	52,157,252
2,584,379	420,627,222

It will be seen that the ton-mileage of west-bound through freight actually exceeded the ton-mileage of the local freight movement in the same direction, while the ton-mileage of the east-bound freight movement represented about 57 per cent. of the volume of the local east-bound movement. Combining the ton-mileage movement in both directions the figures stood thus: Through freight, 168,428,618; local freight, 252,198,604. The through movement represented about 40 per cent., and the local movement about 60 per cent. of the entire ton-mileage.

THE PENNSYLVANIA TONNAGE TAX.

The importance of the Pennsylvania Railroad as a competitor for through business was greatly increased in the early part of the seventh decade by the removal or abrogation of the tonnage tax, previously imposed on freight forwarded over its lines. The amount of this imposition represented a larger sum per ton per mile than has sometimes been charged for the entire movement by railway companies, and its abrogation was an absolute necessity as a precursor of extensive competitive through movements, as the handicapping of one company by such a tax, when its rivals were not subjected to it, would have created a fatal obstruction. Any reasons that may have existed for imposing the tonnage tax while the state owned the main line of combined railways and canals necessarily lost their force when the Pennsylvania Railroad Company became the purchaser of that main line, and this fact seems to have been recognized by the framers of the law which provided for the sale of those works, passed May 16th, 1857. It fixed the minimum price for the main line at $7,500,000, and provided that if the Pennsylvania Railroad became the purchaser it should pay $1,500,000 additional, and in consideration was to be relieved of all taxes on tonnage or freight carried over the road, as well as of other taxes which were specified. But although the Pennsylvania Railroad became the purchaser under this act, the tonnage tax was not at once abolished, on account of a decision of the Supreme Court of Pennsylvania that so much of the act of 1857 as related to the general taxes imposed was unconstitutional. The company was thus placed in an embarrassing position, from which, after protracted litigation, it was finally relieved by new state legislation, perfected March 7th, 1861, which provided that the Pennsylvania Railroad was to pay, in annual instalments, the sum of $13,570,000 to the state in full for the purchase of the main line and the repeal of the tax. Other provisions of this law obliged the company to construct several important branches. Its passage placed the Pennsylvania Railroad Company, for the first time, on equal terms with its trunk-line competitors in matters relating to taxation. And as this important legislation was secured largely through the personal efforts of Colonel Thomas A. Scott, who was at that time vice-president, after having previously been general superintendent of the Pennsylvania Railroad, it materially increased his prestige as an able and influential railway manager.

CONTESTS FOR CONTROL OF DESIRABLE CONNECTIONS.

Some of the most exciting incidents of the seventh decade hinged on efforts to gain or preserve control of western connections, such as the attempt of the Erie managers, in 1869, to secure possession of the Pittsburgh, Fort Wayne and Chicago, which had previously been, and continued to be, the most valuable connection of the Pennsylvania west of Pittsburgh, in the matter of securing through traffic. The following reference to this episode is contained in the annual report of J. Edgar Thomson, made in the early part of 1870:—

"The original policy of this company was to reach the traffic of the north-west, west, and south-west, by assisting the construction of tributary lines leading to the markets of these sections, but not to control their management beyond the state of Pennsylvania. With this object in view, it gave to the Pittsburgh, Fort Wayne and Chicago Railway Company at several periods of its extremest need, large advances to complete its lines and preserve its property to its shareholders, and secured written pledges that its eastward business should follow the direction which prompted and justified this company in granting the assistance so earnestly solicited. Under the conviction that this agreement was ample, it was not believed that further protection to your interests in the north-west was either desirable or important. The rapid growth of this section of the country, however, placed that company, in a few years after its completion, in a condition of great prosperity. It then, unmindful of its former obligations, endeavored to seek other eastern connections that it could control, though this company at all times gave to its business the same rates per mile that it charged upon its own line, upon both passengers and freight. Extensive surveys were accordingly made of the regions east of Pittsburgh by that company to find a suitable line for this object, followed by material pecuniary advances to a railway company whose road it was proposed to use, as a part of this rival route to the east; but during the progress of these movements, an offer was made by the Erie Railway board to absorb not only the Pittsburgh, Fort Wayne and Chicago line, but nearly all the western connections of the Pennsylvania Railroad Company, which only failed from a misapprehension of the terms of the law under which they proposed to accomplish their object, and subsequent adverse legislation procured by the president of the Fort Wayne company.

In view of these extraordinary movements, it became evident to your board that this company must depart from the policy that had heretofore governed it, and obtain direct control of its western connections. Negotiations were accordingly opened with the directors of the Pittsburgh, Fort Wayne and Chicago Railway Company, who had become apprehensive, under the vicious system that had been developed in New York, by which stock and bondholders of railways and their agents sold their proxies to vote at the elections of the company, without any regard to the interests involved in the issue, that their own work might fall into hands whose object would be to seriously impair the permanent interests of their constituents.

After a lengthy negotiation with the directors of that company, a lease was agreed upon, and this company entered into possession of the Pittsburgh, Fort Wayne and Chicago Railroad on the 1st of July last. The terms of this lease, which gave to the shareholders 12 per cent. on their capital, were at the time considered very onerous, and only justified by the circumstances already referred to. The results of its operation, however, for the first half year, notwithstanding a diminished revenue of $304,595.90, compared with that of the same months in 1868, have, through a vigorous retrenchment of expenses, left a net profit of $36,794.43 over all outlays, including the semi-annual contribution of $52,050 to the sinking fund.

For these favorable results the company is much indebted to the energetic and economical administration of its affairs by J. N. McCullough, Esq., its general manager."

The same report also makes important references to negotiations by which the permanent control of lines leading to Cincinnati and St. Louis had been secured.

The significance of this and other conflicts between the trunk lines for the control of various western connections will be better understood by a brief reference to their original position, and to new developments progressing in the closing year of the seventh decade. The Pennsylvania, when it first reached Pittsburgh was so largely dependent upon the Ohio river for western connections that during the sixth decade it was said that the leading element of the prosperity of the railroad was the condition of the navigation of the Ohio. In other words, during a season of low water there were relatively small dividends, while in a high-water season either the dividends or surplus rose to a relatively high-water mark. None of the other trunk lines were then so disadvantageously situated in the matter of western water connections, inasmuch as both the New York lines had outlets on lake Erie, with its superior facilities for water communication with the west and north-west, and all the lake cities, while the Baltimore and Ohio touched the Ohio at points lower down the river than Pittsburgh, and less likely than that city to have their commercial relations obstructed by low water.

It was, therefore, more necessary to the Pennsylvania than to either of the other trunk lines to secure reliable rail connections with the lakes, and it was probably the pressure of this necessity which led, at a relatively early period, to the extraordinary efforts of her managers to secure the numerous connections with western lake and river ports which they obtained.

COMPETITION BETWEEN RAIL AND WATER ROUTES FOR THROUGH EAST-BOUND MOVEMENTS OF BREADSTUFFS.

About 1869 the significance of these connections became greater than ever before, because the length of rail movements of western produce had then materially increased, on account of growing confidence in the practicability of successful rail competition with the western lake and river water carriers. The charges of the latter were then usually maintained at a standard that afforded a liberal margin of profit for competitive rail movements. It was said about 1869 that grain could be moved from St. Louis to the North Atlantic seaboard for a much smaller sum than the usual rate for carrying it from St. Louis, on steamboats, down the Mississippi, to New Orleans, and the ordinary charges for all river and lake movements were much higher than the railway rates for corresponding service which became common during the eighth decade.

The strong tendency towards a relative increase in the east-bound rail shipments is shown by the following statement of the shipments of wheat and flour east from Chicago in the years named:—

Years.	Wheat, bushels. By lake.	Wheat, bushels. By rail.	Flour, barrels. By lake.	Flour, barrels. By rail.
1863	10,646,552	89,861	1,207,345	311,884
1864	9,983,567	173,392	1,034,793	249,417
1865	6,502,575	866,028	646,356	646,372
1866	5,827,846	4,055,303	481,491	1,499,816
1867	8,492,187	1,899,277	650,367	1,364,576
1868	8,896,647	1,402,816	774,565	1,624,500
1869	11,279,514	1,895,123	829,272	1,508,855
1870	13,429,069	2,902,953	574,393	1,129,074

A very important feature of the trunk-line operations hinges on the fact that it was only towards the close of the seventh decade that it became common to regard them as important competitors for the east-bound movement of grain from Chicago or other traffic centres in the Mississippi valley, or even from Buffalo to the city of New York, during summer months, when navigation on the lakes and canals was practicable, while during the next decade they frequently competed with the lake and canal carriers.

A table of the average rates charged on wheat, per bushel, by the three routes, viz., all rail, lake and rail, and lake, canal, and Hudson river, during each month of the years 1868, 1869, 1870, 1871, and 1872, forms part of the report of the Senate committee on transportation routes to the seaboard, made in 1874. It shows that the all-water rates were usually much higher than railways have since attempted to obtain for all-rail service; that the water rates were high enough to stimulate rail competition; and indicates that, in connection with such movements, as well as nearly all other important internal freight movements, really low charges were never permanently maintained before an era of active rail competition. The table is as follows:—

Average monthly freight charges per bushel on wheat from Chicago to New York by water (lakes, Erie Canal, and Hudson river), by lake and river, lake to Buffalo, and thence rail to New York, and by all rail, 1868 to 1872, inclusive:—

Month.	1868. All water.	1868. Lake and rail.	1868. All rail.	1869. All water.	1869. Lake and rail.	1869. All rail.	1870. All water.	1870. Lake and rail.	1870. All rail.	1871. All water.	1871. Lake and rail.	1871. All rail.	1872. All water.	1872. Lake and rail.	1872. All rail.
	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.
Jan.	..	..	51	..	..	42	..	..	42	..	..	39	..	..	39
Feb.	..	..	51	..	..	39	..	..	42	..	..	39	..	..	39
Mar.	..	..	48	..	..	30	..	..	36	..	..	30	..	..	36
Apr.	..	28	42	..	26	30	..	22	30	..	22	27	..	..	30
May.	20	26	36	19	25	30	16	20	27	16	21	27	18	25	27
June.	19	25	30	21	25	27	16	21	27	16	21	24	21	23	27
July.	18	25	33	18	23	27	15	20	27	16	22	27	23	23	27
Aug.	22	26	36	19	20	30	15	20	27	18	24	30	22	23	27
Sept.	25	33	39	22	22	39	15	23	30	23	28	33	27	32	33
Oct.	27	34	42	29	27	39	21	25	36	27	32	39	31	37	39
Nov.	28	35	45	32	36	42	20	29	39	25	32	39	28	38	39
Dec.	..	..	45	..	..	42	..	..	39	..	..	39	..	..	39
Av.	25.3	..	42 6	24.1	..	35.1	17.5	..	33.3	21.6	22.3	31	26.6	28.8	33.5

The general effect of the rail competition with water carriers for the east-bound movement of breadstuffs, during the period referred to above, was to divert to the railways a comparatively small proportion of the shipments of wheat and corn, but a very large proportion of the shipments of flour. In 1863 1,207,345 barrels of flour were sent east from Chicago by lake and 381,884 barrels by rail. In 1872 323,457 barrels were forwarded by lake and 1,136,670 by rail, and progress towards this notable change in the proportions of flour carried by the respective routes was continuous.

REDUCTIONS OF RAIL RATES FOR LIVE STOCK AND WEST-BOUND MOVEMENTS.

Live-stock shipments were also the subject of frequent rival trunk-line movements eastward, some of which were occasionally made at very low rates. At one time cattle were taken from Buffalo to New York for $1 per car by the New York Central and Erie.

West-bound freight movements of merchandise also became the subject of sharp competition, and the extreme measures resorted to at sundry periods are indicated by the fact that the Financial Chronicle, of February 27th, 1869, says: "The war between the Pennsylvania Central, New York Central, and Erie railways, as to rates on through freight from New York or Boston to Chicago, has resulted in a reduction in price to 30 cents per 100 pounds on all classes of freight. This is the lowest price ever made, and is a decline of $1.58 per hundred in ten days."

This extreme reduction seems to have been followed, after a brief period, by an advance in rates, which, in turn, was succeeded by a prolonged reduction, as will be seen by the following table of west-bound rail rates from 1862 to end of 1870:—

NEW YORK TO CHICAGO.

In cents per 100 pounds.

Date.	First class.	Second class.	Third class.	Fourth class.	Special class.	Special class.
January 1st, 1862	160	128	107	66	..	..
April 7th, 1862	149	117	85	50	..	..
October 29th, 1862	180	150	124	75	..	..
May 14th, 1863	166	117	94	55	..	..
October 5th, 1863	160	128	107	66	..	..
November 23d, 1863	180	150	124	85	..	..
July 25th, 1864	200	166	111	85	..	..
September 20th, 1864	215	180	120	82	..	..
May 24th, 1865	215	180	106	96	..	..

Date.	First class.	Second class.	Third class.	Fourth class.	Special class.	Special class.
October 16th, 1865	215	180	90	82	..	..
February 5th, 1866	215	170	82	82	..	..
March 5th, 1866	188	160	127	82	..	..
May 15th, 1867	188	160	127	82	..	..
November 5th, 1867	202	170	138	86	..	..
June 4th, 1868	188	160	127	82	..	..
August 10th, 1868	149	128	120	82	..	..
September 7th, 1868	188	160	127	82	55	..
February 4th, 1869	188	160	127	82	55	..
February 18th, 1869	45	45	45	45	45	..
February 24th, 1869	40	40	40	40	40	..
March 15th, 1869	160	160	127	82	55	..
July 1, 1869	188	160	127	82	55	..
July 31st, 1869	70	60	55	50	30	..
August 2d, 1869	45	45	45	45	40	..
August 4th, 1869	40	40	40	40	30	..
August 5th, 1869	30	30	30	30	30	..
August 7th, 1869	25	25	25	25	25	..
August 23d, 1869	38	38	38	38	38	..
August 30th, 1869	43	43	43	43	43	..
September 22d, 1869	40	40	40	40	40	..
September 24th, 1869	35	35	35	35	35	..
September 30th, 1869	30	30	30	30	30	..
October 4th, 1869	50	50	50	50	50	..
October 9th, 1869	75	75	75	50	50	..
October 13th, 1869	125	100	75	65	50	..
November 1st, 1869	140	125	100	80	50	..
November 29th, 1869	150	130	100	80	55	..
June 13th, 1870	112	90	70	55	45	..
July 12th, 1870	80	70	60	50	42	35
July 25th, 1870	65	60	55	45	40	35
July 28th, 1870	50	50	50	45	40	35
August 12th, 1870	50	50	50	50	40	..
August 22d, 1870	100	90	70	55	45	..
September 8th, 1870	125	110	85	65	50	..
November 28th, 1870	160	130	100	65	..	..
December 26th, 1870	180	150	120	80	60	..

RELATIVE DECLINE OF WATER-ROUTE MOVEMENTS.

The extent to which prevailing influences have promoted the rapid growth of railway tonnage, while canal and some other water-route movements were actually or relatively declining, is shown by the following table, which, in illustrating what occurred in New York, typifies, to a considerable extent, corresponding changes elsewhere:—

Total tonnage moved each year on the Erie Canal, on the Erie Railway, and on the New York Central and Hudson River Railway, from 1856 to 1872, inclusive:—

Year.	Tons moved on the— New York Central and Hudson River R. R.	Erie Railway.	Erie Canal.
1856	776,112	943,215	2,107,678
1857	838,791	978,066	1,566,624
1858	765,407	816,954	1,767,004
1859	834,319	868,073	1,753,954
1860	1,028,183	1,139,554	2,253,533
1861	1,167,302	1,253,418	2,500,782
1862	1,387,433	1,632,955	3,204,277
1863	1,449,604	1,815,096	2,955,302
1864	1,557,148	2,170,798	2,535,792
1865	1,275,299	2,234,350	2,523,490
1866	1,602,197	3,242,792	2,896,027
1867	1,667,926	3,484,546	2,920,578
1868	1,846,599	3,908,243	3,346,986
1869	2,281,885	4,312,209	2,845,072
1870	4,122,000	4,852,505	3,083,132
1871	4,532,056	4,844,208	3,580,922
1872	4,393,965	5,564,274	3,562,560

FAST FREIGHT LINES.

ONE of the developments which commenced, on a limited scale, previous to the seventh decade, greatly increased in importance between 1860 and 1870, and subsequently exercised a great influence on all lengthy competitive railway operations, and in attracting traffic, was the establishment of fast freight lines.

There are few subjects which have elicited a greater variety of contradictory opinions among experts, not in regard to the value of fast freight lines, in themselves, which is universally conceded, but in reference to the conditions under which they should be organized.

NON-CO-OPERATIVE FAST FREIGHT LINES.

Soon after the commencement of the civil war, the closing of the Mississippi as an outlet for western produce, and the necessity of sending portions of it eastward over rail or water routes to north Atlantic ports from regions which had previously usually found a market either in southern or southwestern states, or through their water channels, together with a rapid growth of the eastern and European demand for American breadstuffs and provisions, and various other causes, greatly increased the requirements for the freight cars available for through movements.

This occurred at a time when nearly all prices were abnormally high, and when the first cost of such cars, in greenbacks, represented a much larger sum than had previously been paid for them in gold or its equivalent. There was no doubt of the fact that, temporarily, there was an abundance of profitable employment for such cars, but much uncertainty prevailed in regard to the duration of this urgent demand, as it was thought it might suddenly cease, through the close of the war or the reopening of the Mississippi, in which event companies that had purchased abnormally expensive cars might find their investment unprofitable.

Partly on account of this consideration, some railroad companies adopted the policy of leaving private organizations, in which it was alleged a number of their officers were interested, to assume the risks of constructing and operating fast freight lines, the railway companies charging and receiving in one form or another a toll and a charge for motive power, or other similar compensation, for the use of their roads, instead of attempting to secure all the profits that could be realized from the ownership of cars, and assuming the accompanying risks.

This was designated the non-co-operative fast freight line system, and from time to time it was vigorously denounced, chiefly on the ground that it enabled officers of the lines traversed to make profits that should have been secured for stockholders, until finally, after the lapse of years, the clamors became so great that in substantially all important instances this form of non-co-operative fast freight lines was abolished, by the purchase of their cars and other appurtenances, and the acquisition of the control of their organizations, by some one or more of the railway lines over which they had conducted traffic movements during the period of their independent corporate existence.

Other companies, or combinations of companies, constructed and organized fast freight lines, consisting of cars applicable to lengthy competitive movements, or to some other particular specified kind of transportation, which were known as

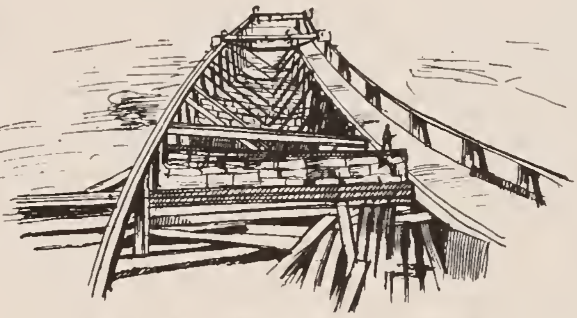
CO-OPERATIVE FAST FREIGHT LINES.

The leading feature of this class of lines hinges on the fact that all the cars used by them belong to some one or more of the companies whose lines are traversed, as absolutely as the freight cars used in local traffic (except so far as ownership may be modified by car-trust obligations.)

The usual practice in forming such lines, when they are intended to run over the tracks of three or four independent but connecting roads, has been for each road to furnish a proportion of the entire number of cars used, corresponding as closely as possible to the length of its track or the probable amount of the through traffic it would secure, and at frequent intervals the respective companies present and settle accounts, the settlements being based on the theory that each railway company shall receive its just share of the proceeds of the work performed by all the participating companies.

On some important roads the principle of prorating freight

Leveling Party.



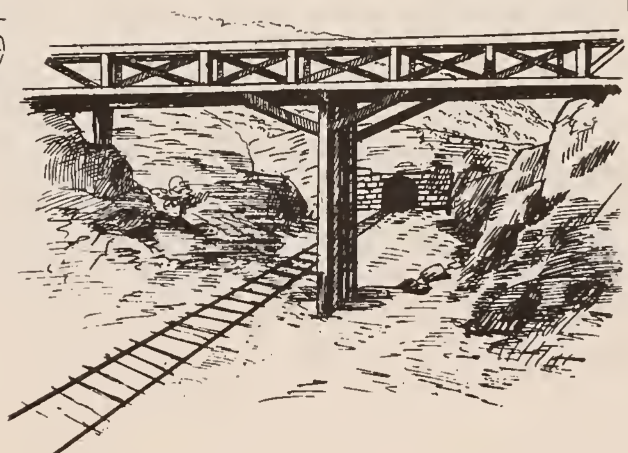
Viaduct in Course of Construction.

Diagram of Gradients.

Making a Cutting.

Track-Laying.

Making an Embankment.



Overhead Farm or Road Bridge.

PROGRESS OF CONSTRUCTION.

charges was never successfully applied before co-operative freight organizations commenced operations, and, generally speaking, it may be said that only a very small proportion of the through-rail freight movements of the country would ever have been possible without the aid of either the non-co-operative or the co-operative freight lines, because it was mainly, and almost exclusively, through them, that the transfer of freight from one set of cars to another set of cars, at the connecting point between two lines, was abolished, and many delays and additions to the cost of lengthy movements thus avoided. Such avoidance was absolutely necessary to secure for the railways interested much of the traffic they have obtained.

GENERAL EFFECTS OF FAST FREIGHT LINES.

It is impossible to exaggerate the importance of fast freight lines as promoters of the free and frequent railway movement of immense quantities of products of all descriptions between distant points. They accomplished a leading purpose of consolidations of connecting railways by rendering prompt, rapid, and continuous movements over the roads of numerous companies possible, and by furnishing reliable guarantees to shippers in respect to payments for damages arising from thefts, accidents, or other causes. They also established effective commercial agencies, or corps of drummers or solicitors, as well as authorized agents, at numerous points, and provided every desirable adjunct for obtaining, stimulating, and transacting in a satisfactory manner all classes of freight business that could be diverted to the roads they respectively represented. In many instances, instead of waiting for business, they sought it, especially from shippers who forwarded considerable quantities, and the American drummer, who travels for metropolitan wholesale establishments, seeking custom in competition with keen rivals of his own class, has found a worthy prototype among attachés of some of the fast freight lines of the country. In short, the opportunity of supplying transportation at a vast number of times and places has been bid for, and underbid for, to an extent which can scarcely be conceived, and very often the winners in the numerous strifes that have occurred between rival lines have finally carried off the prize of a contested shipment under conditions that netted a loss instead of a profit to the fast freight line and the railway companies concerned. While much mischief has been done in this way—so much that it may be questioned whether there is any single cause of the demoralization of freight rates, and injurious discrimination between persons and localities, more potent than those arising from the operations of fast freight lines—they have been principal instrumentalities in hastening the wonderful development of internal commerce between distant points, in diverting traffic from water to rail routes, and in attracting to the lines of leading railways the enormous amount of through-freight business they have transacted. Their operations, in the aggregate, have been conducted on a gigantic scale, in reference to the capital employed, number of cars used, and extent of freight movement.

RELATIVE MERITS AND DEMERITS OF THE CO-OPERATIVE AND NON-CO-OPERATIVE SYSTEMS.

Practically, the non-co-operative fast freight line system stands condemned and abolished. It has been almost, if not quite, universally supplemented by the co-operative system, under which the railway companies concerned, collectively, own all the cars employed and assume all the risks. During the seventh decade such a conclusion had by no means been reached; fast freight lines of both classes were then, and for some years later, in vigorous operation; and at sundry times where a choice between them was necessary, counter objections were made to the co-operative system.

What has happened in American railway development, in this connection, is substantially this: The non-co-operative method was applied, on an extensive scale, to three things, viz.: First, express company movements; second, fast freight line movements; third, sleeping and palace car movements. There has been at different times, an urgent demand for an assumption of the risks and a procurement of the profits of all these three classes of business, by each of the important railway companies whose lines were traversed, and this demand has, in a comparatively few instances, received sufficient attention to secure complete compliance; but on the main portion of the mileage concerned, the express and sleeping-car movements have always been conducted on the non-co-operative system, or by companies which maintained an independent existence, while a different conclusion has almost uniformly been reached in reference to fast freight lines.

There may, or may not, have been sufficient reasons for this divergence in particular cases, but if the matter be reviewed as an abstract question, or an original proposition, or with reference to its bearing on railway prosperity, it seems by no means certain that non-co-operative freight lines, in themselves, deserve the condemnation they have received.

Public opinion on this subject apparently rushed from one extreme to the other. At the outset great discontent prevailed in some localities because every man could not drive his own vehicle, with his own horse, on a railway, and even after it was discovered that the benefit of steam power, exerted through locomotives, could not be utilized by those who were unwilling to submit to such regulations as were necessary to insure speed and safety, much stress was laid upon the doctrine that all railways should be public highways in as full a sense as their peculiar characteristics permitted.

This doctrine has been deeply rooted in the railway legislation of some states, and in accordance with it, much transportation service has been performed by a number of cars which did not belong to the companies whose lines were traversed, or to any other railway company. So far from such transactions being necessarily objectionable, provided the cars were kept by their owners in proper condition for movement, they have not unfrequently been encouraged, and in general terms it may be said that there are few, if any, important railway companies whose lines are not frequently traversed by cars that belong either to individuals or other companies.

But notwithstanding the continuance of such practices, a strong sentiment has been developed, in many quarters, chiefly among owners of railway securities, that every railway company should make strenuous efforts to provide all the cars required for all classes of traffic that pass over its lines. If it was absolutely certain that the pecuniary interests of all railway companies would uniformly be promoted by a rigid adherence to such a policy, there would be very good reasons for its enforcement. But this is by no means the case. The real question involved hinges on the extent to which the interest of sundry companies might be promoted if the general public, or combinations which desire to organize fast freight lines, could be induced to furnish and forward cars. The opponents of the co-operative fast freight line systems have contended that one of their inevitable effects has been to stimulate the demoralization of rates, and if all the numerous pooling systems which have been tried with varying success should finally prove to be hopeless failures, it is among the possibilities of the future that partial relief may eventually be found in a general adoption of non-co-operative fast freight line systems.

OPERATIONS OF THE ANTHRACITE COAL ROADS

FEW of the remarkable developments of the seventh decade excited more interest in financial circles, and made a greater impression upon money markets, industrial centres, and transportation systems, than those interwoven with the anthracite coal trade, and the operations of the canal and railway anthracite coal carriers. The lines of theso carriers formed the oldest important artificial routes that had been constructed by private capital. It was to carry coal from the anthracite regions that the first American railways of considerable consequence had been built. It was on an anthracite railway that the first American locomotive service had been performed. It was on early anthracite railways that the movement of a large freight tonnage, in proportion to mileage, commenced. Before the war these anthracite roads and routes had attained great magnitude, for that era. A list or estimate, compiled about 1857, showed that at that time there was in operation 758 miles of canal and 1,030 miles of railway, including underground roads and roads owned by individuals, which had cost $67,297,569, that had been built chiefly for the movement of anthracite. Although that business had then been progressing for more than a generation, and a considerable increase of shipments had been reported each year from 1820 to 1856, inclusive, except 1834 and 1838, it was still comparatively in its infancy, and subsequently there was a great increase in the traffic and the capital of coal roads. The aggregate amount of the shipments in 1856 was 6,927,580 tons. The tonnage from 1856 to 1870 was, according to one of the statistical reports pertaining to this subject, divided between the respective anthracite fields or regions, as follows:—

PROORESS OF THE ANTHRACITE COAL TRADE.

Year.	Lehigh. Tons.	Schuylkill. Tons.	Wyoming. Tons.	Lykens Val., Shamokin. Tons.	Total. Tons.
1850	1,351,970	3,289,585	1,972,581	313,444	6,927,580
1857	1,318,541	2,985,541	1,952,603	388,256	6,664,941
1858	1,380,030	2,902,821	2,186,094	370,424	6,759,369
1859	1,628,311	3,004,953	2,731,236	443,755	7,808,255
1860	1,821,674	3,270,516	2,941,817	479,116	8,513,123
1861	1,738,377	2,697,439	3,055,140	463,308	7,954,314
1862	1,351,054	2,890,593	3,145,770	481,990	7,875,412
1863	1.894,713	3,433,265	3,759,610	478,418	9,566,006
1864	2,054,669	3,642,218	3,960,836	519,752	10,177,475
1865	2,040,913	3,755,802	3,254,519	621,157	9,652,391
1866	2,179,364	4,957,130	4,736,616	830,722	12,703,822
1867	2,502,054	4,334,820	5,325,000	826,851	12,991,725
1868	2,507,582	4,414,356	5,990,813	921,381	13,834,132
1869	1,929,523	4,821,253	6,068,369	903,885	13,723,030
1870	3,172,916	3,853,016	7,825,128	998,839	15,849,899

In no other portion of the United States has the amount of tonnage represented by the above figures, to be moved by canals or railways (and as years progressed, to an increasing extent by railways), originated in a territory no larger than the anthracite area worked. One of the very greatest of the schools for all descriptions of railway training, including mechanical progress, labor troubles, financial ingenuity, corporate rivalry, and pooling devices or their equivalent, has been furnished by anthracite coal traffic and production and its adjuncts. All the coal reported above was moved for some distance either to points within the state of Pennsylvania, or to places beyond its boundaries, many shipments being to comparatively distant points. Much of that coal was mined by managers or companies controlled by the transporting lines, which thus combined, to an extent unparalleled in other pursuits, the business of miners and sellers of coal with that of transporters. Of the relative position of the companies in this respect, which formerly prevailed, the United States Railroad and Mining Register, of May 21st, 1864, said: "The great trunk outlets from the Schuylkill or southern coal field, which includes the Mahanoy basin, are simply carriers, nothing more, the Philadelphia and Reading Railroad, the most potent of all the lines, having always made it its policy to carry for and co-operate with the operators of mines, as likewise has also the Schuylkill Canal.

Of the outlets down the Lehigh, the Lehigh Valley Railroad is, like the Philadelphia and Reading, a *common carrier;* the Lehigh Navigation Company, on the other hand, mines and sells as well as carries coal.

Of the outlets from the Lackawanna coal field, all the three tideward outlets combine and exercise mining, commercial, and transportation privileges, to wit: The Pennsylvania Coal, the Delaware and Hudson Canal, and the Delaware, Lackawanna and Western railroad companies."

Attempts to secure combined powers, however, were occasionally made. In January, 1864, A. G. Curtin, Governor of Pennsylvania, vetoed several bills which were intended to confer joint privileges of mining and transporting coal, and in one of these veto messages he said: "I am determined to approve no bill giving a new monopoly of the kind, or giving to one already existing, the right of holding a larger quantity of land than they are now authorized to acquire."

EXTRAORDINARY PROSPERITY DURING THE WAR ERA.

One of the results of the war was to temporarily give to the business of mining and transporting anthracite a degree of profitableness which far exceeded the most sanguine expectations of the projectors, operators, and investors interested. At last, after years of struggles, many of which had been as disastrous as they were difficult, the "black diamond" mines had proved veritable bonanzas for all concerned, on account of the great increase in the demand and market price of anthracite coal, which carried with it enormous wages for the miners, and high profits for operators and transporters.

The extent of these profits is indicated, but not fully explained by the following comparative statement of cash or stock dividends declared by leading anthracite mining or carrying companies from 1862 to 1867, inclusive, which is compiled from a tabular statement in the railroad report of the Auditor-General of Pennsylvania for the year 1867, viz.:—

	1862.	1863.	1864.	1865.	1866.	1867.
Delaware and Hudson Canal and railroad	7	8½	36⅔	34	16	..
Delaware, Lackawanna and Western	..	24	5	15	20	*10 †75
East Mahanoy	..	..	..	6	6	6
Hazleton	5	8	12	10	10	9
Lehigh Luzerne	6	8	12	9½	14½	6
Lehigh Valley	8	10	20	10	20	10
Little Schuylkill Navigation and Coal	..	3½	6	3	2	..
Lykens Valley	12	8	6½	4½	9	9
Mill Creek and Mine Hill Navigation	10	10	10	10	10	10
Mine Hill & Schuylkill Haven	8½	8	7 7/16	8	8	8
Mount Carbon	6	6	6	6	6	6
Mount Carbon & Port Carbon	12	12	12	12	12	12
Philadelphia and Reading	†7	‡10½ 7	3½ 7	15	10	§10
Schuylkill Valley Navigation	..	5	5	5	5	5
Shamokin Valley & Pottsville	..	1½	3	4	4½	5½

* On stock. † Per share—scrip. ‡ On preferred stock. § 5 cash and 5 stock.

The Lehigh Coal and Navigation Company, which is not included in the above list, although one of the important anthracite carriers, paid a dividend of 5 per cent. on November 27th, 1866, and a dividend of 3 per cent. on May 28th, 1867. During the flush times it was spending large sums for the construction of a railway. The Schuylkill Navigation paid a dividend of 6 per cent. per annum for the year 1867.

The determination of the Lehigh Coal and Navigation Company to speedily construct a railway from the Lehigh coal mines to Easton, that would parallel the Lehigh Valley, first became known about June, 1864. About the same time the

Lehigh Valley effected a consolidation with the Beaver Meadow. One of its effects was to extend the control of the Lehigh Valley over roads leading to numerous important portions of the anthracite coal regions.

The significant changes in the price of anthracite were accompanied, to a considerable extent, with fluctuations in the market value of leading anthracite stocks. Delaware, Lackawanna and Western, which sold in New York for 54, in January, 1860, sold for 130 in December, 1862; 225@230 in December, 1864; 175 in December, 1865; 144½ in December, 1866; 111¼@114 in December, 1867; 125@131 in December, 1868; 105¾@108 in December, 1869; and 101¾@110¼ in December, 1870. Philadelphia and Reading sold in the New York market, for 29½@36½ in December, 1860; 30½@34¼ in December, 1861; 74¾@77¼ in December, 1862; 111¼@122 in December, 1863; 112¾@137¼ in December, 1864; 105¾@117¼ in December, 1865; 108@112¾ in December, 1886; 91¼@96⅝ in December, 1867; 96¼@98½ in December, 1868; 97¾@101¼ in December, 1869; and 96¼@104¼ in December, 1870. The figures given above represent, in each instance, twice the actual sum paid for a single share of stock, as the par value of the stock of both companies is $50, while all New York stock transactions are reported on the basis of a par value of $100.

On March 4th, 1864, sales occurred at the New York Stock Stock Exchange at these prices:—

Capital shares Delaware and Hudson Canal Company	$230
Capital shares Pennsylvania Coal Company	204
Capital shares Delaware, Lackawanna and Western Railroad Co.	230
Capital shares Reading railroad	136¼

On March 30th, 1864, a notable event at the Philadelphia stock boards consisted of an advance of the price of Reading stock to higher figures than those which Pennsylvania Railroad shares commanded on that day, this being the first time for years that such a relation had existed. The highest price of the Pennsylvania shares on that day was $75¼, and of the Philadelphia and Reading, $76½. (These prices were based on the recognition of the true par value of $50 per share.)

Of the earnings of the Philadelphia and Reading for September, 1863, on the main line of 93 miles, it was stated that they were $714,302, equal to $7,680 for each mile of main road, in a single month. Of its earnings for October, 1863, it was reported that they were $815,902.03, or at the rate of $8,773 per single mile of main line, in a single month. These receipts, however, presumably included charges for a considerable amount of service on lateral lines leading to coal mines.

The tonnage of six leading anthracite carriers in 1863 was subdivided as follows:—

	Tons.
Schuylkill Canal	854,554
Philadelphia and Reading Railroad	2,849,408
Lehigh Canal	699,598
Lehigh Valley Railroad	1,195,555
Delaware and Hudson Canal	1,490,105
Delaware, Lackawanna and Western	1,223,166

In addition to these movements from the mines, or their immediate vicinity, the Central of New Jersey was an important agent in transporting coal through New Jersey. In 1863 it reported the carriage of 1,049,881 tons, against 816,570 tons in 1862; an increase of 111,579 tons in Lackawanna coal and 121,732 tons in Lehigh coal; and an increase in receipts for coal transportation from $661,280.85 in October, 1862, to $1,021,151.57 in 1863. The report refers to the fact that rates for transportation had been previously advanced with the increase in the price of coal.

In 1863 there were also shipped from the Philadelphia and Reading Railroad, through the Delaware and Raritan Canal to New York, 514,583 tons of coal, and the amount forwarded over the same route that had come to tide-water on the Delaware from the mines, via the Schuylkill Canal, was 529,219 tons.

The coal tonnage forwarded over anthracite coal roads and canals in 1864 was as follows:—

	Tons.
Philadelphia and Reading	3,065,577
Schuylkill Canal	1,000,500
Lehigh Valley Railroad	1,295,419
Lehigh Canal	758,087
Delaware, Lackawanna and Western	1,302,456
Delaware and Hudson Canal*	848,076
Pennsylvania Coal Company	759,544
	9,029,659

* The Pennsylvania Coal Company in 1864 shipped 504,507 tons by the Delaware and Hudson Canal, which makes the whole tonnage moved on that canal for the year 1,362,583 tons.

The coal tonnage of the Philadelphia and Reading, during each year of the seventh decade, is reported by that company as follows: 1860, 1,946,195 tons of 2,240 pounds; 1861, 1,639,535; 1862, 2,310,990; 1863, 3,065,261; 1864, 3,065,577; 1865, 3,090,814; 1866, 3,714,684; 1867, 3,446,826; 1868, 3,574,874; 1869, 4,239,457.

What west-bound transportation of anthracite coal cost in 1865 may be inferred from the fact that on January 20th the wholesale prices at Detroit were, for Lehigh, $19; Scranton, $16; and Blossburg $14.50 per ton.

The fluctuations in the value of the Delaware, Lackawanna and Western, as well as its profits and dividends, were much greater than those of the Reading, mainly because the first-named company combined the functions of mining with those of transporting to a considerable extent, thus deriving large profits from mining operations, while the Reading was not then the owner or operator of coal lands.

The remarkable advances that had occurred are shown by the following graphic statement in the United States Railroad and Mining Register, in October, 1863:—

"In September, 1861, Schuylkill lump coal sold in Philadelphia, by the cargo, for $3.25 per ton. Now it sells for $7.25 per ton—more than twice as much. The advance is divided between the operators and the carriers, the first parting with a portion of his increase to his miners and laborers, the carrying corporation dividing its increased profits among its stockholders.

When coal was sold for $3.25 at the state line, it commanded about $2 for the operator at the shipping point in the mining region, leaving about $1.25 for transportation to the state line. Now, whilst it sells for $7.25 at the state line, it commands about $4.75 for the operator at the shipping point in the mining region, leaving about $2.50 for transportation to the state line.

And as the coal mined on the anthracite territory this year will be about ten million tons, of which 60 per cent., or six million tons, will cross the boundary of the state into outside markets, the advance of four dollars per ton on the six million tons exported will bring into Pennsylvania from her anthracite customer states in 1863 about twenty-four million dollars over the proceeds of the anthracite exported in 1861, only two years ago."

The duration of anthracite prosperity, and its accompaniments, is indicated by the fact that the average price of Schuylkill white ash lump coal, by the cargo, at Philadelphia, per ton of 2,240 pounds, subsequently fluctuated, in the month of October of each of the remaining years of the seventh decade, as follows: 1864, $8.90; 1865, $9.93; 1866, $5.34; 1867, $4.01; 1868, $4.50; 1869, $6; 1870, $4.19.

REASONS GIVEN FOR EXTENSIVE PURCHASES OF COAL LANDS BY THE READING.

One of the effects of the profitableness of a combination of mining and transporting that had existed during the war was to inspire the active coal transporting companies which had not previously been mining coal, especially the Reading, with the desire to make such combinations on an extensive scale, and out of this desire, and the manner in which it found expression, various results of considerable significance were subsequently developed.

The Philadelphia and Reading report of 1877 contains a statement of the reasons which led it to embark in the extensive purchases of coal lands which commenced about or soon after the end of the seventh decade. It embraces the following remarks:—

"The anthracite district of Pennsylvania is embraced in three principal coal fields and the attached Lehigh basins, and contains about four hundred and seventy square miles. The Schuylkill or lower coal field was first opened and developed, and has depended principally upon the lines of this company for an outlet to market. As the second or Mahanoy coal field was opened, the lines owned or controlled by the company were gradually extended into it, so that, at the close of the late war, the Mahanoy and Schuylkill coal fields depended principally upon the Philadelphia and Reading Railroad Company for transportation; the detached Lehigh basins, upon the Lehigh Valley Railroad and the Lehigh Navigation Company; while the Northern or Wyoming coal region was principally owned or controlled by the three large coal-mining and transporting companies of New York, each of which united under one charter the power to own lands, mine coal, and transport and sell the product of their own estates. The demand caused by the war very greatly increased the productive capacity of all the coal regions, but especially that of the Wyoming or upper coal field, for the transportation of the product of which the Lehigh Valley Railroad Company and the Lehigh Navigation Company gradually entered into competition with the three New York companies.

Had the policy of permitting railroad companies to become the owners of lands, and miners and merchants of coal, not been inaugurated by the commonwealth of Pennsylvania, the Reading railroad company might never have been obliged to resort to the acquisition of coal lands. The regions it drained were nearest to tide-water; its railroad possessed the great advantage of good alignment and favorable grades; and in any competition on terms of equality with other regions, the Schuylkill coal field and the Reading railroad could have maintained their full share of coal tonnage. During the war, when the demand was so great that every miner could sell his entire product, there appeared to be no cause for unfavorable comparison, and this company, in common with others, made large profits out of the business of transporting coal; but when the demand of the war ceased, it was soon discovered that the control of most of the coal markets of the country could be taken by those companies, which, owning, mining, transporting, and selling their own coal, united all the profits of the business, as against the product of a region where tenants paid rent to a landlord for the privilege of mining, and only reached the consumer through the hands of a factor. But in addition to the disadvantages resulting from the different systems of mining, the territory which had been considered as properly tributary to this company, and to develop which its railroads were constructed, was being encroached upon and absorbed by rival companies, who extended their lines and purchased coal land for the purpose of diverting tonnage to their own roads. The Lehigh Valley Railroad Company had purchased controlling interests in large estates near Ashland, and, becoming the owners of the Quakake Railroad, extended the latter through the entire northern section of the Mahanoy coal field as far as Mount Carmel, where a junction was effected with the railway system of the Pennsylvania Railroad Company, who, through the Northern Central Railroad, entered the same coal field from the west, and in the neighborhood of Shamokin had acquired large interests in coal property. This same company, through its ownership in the Northern Central Railroad Company, had obtained control of the Summit Branch Railroad Company and of the Lykens Valley coal region, which forms the western extremity of the northern fork of the southern coal field.

In addition to these, the Lehigh Valley Railroad Company, the Delaware, Lackawanna and Western Railroad Company, and the Central Railroad of New Jersey, then in friendly alliance, had united to locate and construct a line of railway, entering the southern coal field at Tamaqua, and extending westward to the centre of the region, and were actively engaged in preliminary examinations preparatory to purchasing coal lands to supply the new line with tonnage."

DIFFICULTIES OF THE ANTHRACITE LINES.

The notable advance in the price of anthracite during the war also stimulated competition on the part of mining and transportation companies engaged in the development of bituminous and semi-bituminous coal fields in central, southern, and western Pennsylvania and Maryland. The output of bituminous coal in other states also began to increase rapidly before the end of the seventh decade, the general tendency from that time until the present day being to diminish the ratio of anthracite to the total annual product of coals of all kinds, notwithstanding the rapid increase in the output of anthracite.

This tendency increased the difficulties involved in a successful and profitable management of anthracite railway companies, heavily burdened with interest charges for coal lands, mining improvements, and lateral railroads leading to coal mines.

Partly for this, as well as numerous other reasons, including the extraordinary vicissitudes and fluctuations of the coal trade, the powerful coal-carrying companies have for many years made numerous endeavors of various kinds to add to their business sundry other profitable branches than coal mining or coal carrying. From the location of their lines, and diversified character of the interests they serve, all the important anthracite rail carriers were, from the outset, engaged in other railway labors than coal carrying, and some of these lines have transported so many passengers and so much miscellaneous merchandise, exclusive of coal, that they would have been important factors in the railway system if no coal trains had run over their tracks. The Reading, Delaware and Lackawanna, and Lehigh Valley have been specially active in these efforts to extend the scope of their operations. On the other hand, the Pennsylvania, Northern Central and Erie railways have made strenuous exertions to add to their miscellaneous railway labors a large amount of anthracite traffic.

One set of numerous contests which have occurred between trunk lines, and another set of conflicts between anthracite carriers, have gained increased complexity from the extent to which the diverse interests of these two classes of roads were interwoven in connection with the affairs of some of the companies named.

Independent of this particular complication, the anthracite roads, in performing their gigantic labors as coal carriers over tracks on which large movements of miscellaneous kinds were simultaneously being made, were obliged to give attentive consideration to many of the most intricate of the mechanical and engineering railway problems which demanded solution, especially those relating to locomotives, movement of heavy trains, and condition of tracks, and they thus furnished one of the most useful and important of the Americans schools of railway training.

NORTH-WESTERN OR GRANGER ROADS.

THE development of gigantic systems radiating from Chicago, during the sixth and seventh decades, formed one of the most important railway events of that period. While effective links were being established with the eastern trunk lines, and falling, to a great extent, under their control, independent organizations of stupendous magnitude, which led from Chicago in northern, north-western, south-western, and southern directions, were rising in importance, through new construction, consolidations, and growth of traffic, with a rapidity rarely equaled. The first powerful impulse to these movements was probably given by the construction of the Illinois Central, but even before it was commenced, a basis was established for various other important enterprises.

The process of extending the great north-western systems has been progressing since 1870 at a rate which bears a close analogy to its remarkable advancement before that year. A complete history of this rise would require much more space than is here available, but it is necessary that at least brief reference should be made to one of the most important achievements up to the end of the seventh decade.

We have already printed statistics showing how large were the additions to their mileage, and referring to the liberal dividends some of them had earned previous to 1870, but a few of the numerous other particulars relating to their operations may help to convey a realizing sense of their high relative rank as one of the most important portions of the American railway system.

In their forward strides few of the standard railway vicissitudes were avoided. Temporary bankruptcy was found unavoidable by the

ILLINOIS CENTRAL

in 1857, about the time of the completion of the main line, although a few years later, and at all subsequent periods, its financial position was exceptionally strong.

The difficulties arose out of the existence of a floating debt of several millions of dollars, the panic of 1857, and the fact that the net earnings and cash received in the land department during the early years of the operation of the road were not sufficient to pay interest on its construction bonds.

In 1860 the latter difficulty was overcome, and from that time forward a career of great prosperity was secured. It was reported in 1863 that the Illinois Central then had the largest amount of rolling stock of any road in the west, and that it consisted of more than 3,000 first-class freight cars, 100 passenger and mail cars, and 150 locomotives. The net earnings increased from $527,952 in 1855 to $850,765 in 1860, and the cash received in the land department increased from $234,439 in 1855 to $653,312 in 1860. The interest paid on construction bonds was $1,099,723 in 1855 and $1,026,507 in 1860; and while this current annual indebtedness was slightly decreasing, the available net revenue, including proceeds of land sales, was nearly doubled, as it increased from $762,391 in 1855 to $1,503,987 in 1860. The net earnings of 1866 were $2,175,447, and the contract value of the lands sold in that year was $1,683,694. In that year two dividends of 5 per cent. each were paid to stockholders.

The Illinois Central was the first of the land-grant roads, and the transitions in its fortunes noted above were largely due to the fact that the principal portion of its main line was built through a region containing very few inhabitants, and it was necessary that production should be stimulated by its efforts to attract purchasers for the lands embraced in its grant, and the adjacent Government lands, before a considerable amount of either freight or passenger traffic could be secured. Its success in surmounting these difficulties had a powerful influence in promoting numerous other land-grant railway projects, and in increasing the number of land grants made by Congress; and in financial results a considerable proportion of these schemes more closely imitated the unfortunate episode of the Illinois Central than its good fortune.

By a remarkable series of strokes of good fortune in original construction, consolidations, and management, the

CHICAGO AND NORTH-WESTERN

had attained before 1870 a very prominent rank among north-western lines, which it has since preserved. The original movement for the construction of any portion of its present line is traced to the old Galena and Chicago road, which was chartered in 1836. A panic followed in the footsteps of the charter, which delayed further operations until 1847, eleven years later, when the first rail was put down. This was done on what is known as the Galena division, or the Freeport Line. In 1853 the line from Chicago to Freeport, a distance of 121 miles, was completed. The Illinois Central, which passes through Freeport to Galena, enabled the road to extend its operations to the lead mines at Galena. This pioneer was absorbed by the Chicago and North-western road in 1864. In 1854, ten years prior to this consolidation, the Chicago and North-western constructed a line which connects Chicago and Milwaukee.

In 1867 the Chicago and North-western had acquired control of and was operating more than a thousand miles of main line, which practically formed five lines, radiating in northern, western, or north-western directions from Chicago, including the following: 1. A road from Chicago to Milwaukee, 85 miles. 2. A road from Chicago to the head of Green bay, 242 miles. 3. A road from Chicago to Madison, by way of Elgin and Beloit, 147 miles. 4. A road from Chicago to Freeport, by way of Elgin and Rockford, 121 miles. 5. A road from Chicago to Council Bluffs, on the Missouri river, crossing the Mississippi river at Clinton, and proceeding through Iowa, 491 miles.

Important portions of the three states of Illinois, Wisconsin, and Iowa were traversed by these lines, and a connection with the eastern terminus of the Union Pacific was secured. Since 1867 many other extensions and new acquisitions have been made. During the year ending May 31st, 1865, the gross earnings of the road were $6,820,750, which represented an increase over the earnings of the previous year of $2,138,942, or 45.69 per cent.

The origin of the

CHICAGO, BURLINGTON AND QUINCY,

which has now become one of the most important of American railway systems, and extends through more than half a dozen states, is traced to two roads, as follows: On February 12th, 1849, a railroad company was organized in Illinois under the name of the Aurora Branch Railway Company. In June, 1852, the Chicago and Aurora Railroad Company obtained its charter, and immediately proceeded to lay its tracks between Chicago and Aurora. The Central Military Tract Railroad Company owned the road between Mendota and Galesburg, and in 1856, just after the Chicago and Aurora company had completed its line, these two roads consolidated. The company thus formed adopted the name of the Chicago, Burlington and Quincy Railroad Company. From this grew the system which covers so extensive an area.

In 1867 it extended from Chicago to Galesburg, in a general south-west direction, where it forked, one branch reaching the Mississippi river at Burlington, and the other at Quincy. At Burlington it made a connection, after crossing the Mississippi river, with the Burlington and Missouri River Railroad, a road designed to extend the Chicago and Burlington system through Iowa to Council Bluffs, on the Missouri, for the purpose of making a connection with the Union Pacific, of which a considerable proportion had been completed. At Quincy it made a connection with the Hannibal and St. Joseph, through Missouri, which road extended to St. Joseph. Originally the Chicago, Burlington and Quincy entered Chicago from Aurora over the lines of another road, but in 1860 it constructed a line of its own over this route, 40 miles in length, and it had previously completed a branch to Peoria, as well as the lines to Quincy and Burlington. The aggregate length of all these lines in Illinois was nearly four hundred miles, which forms only a small portion of its present mileage.

It has been noted at all periods for excellence of management and readiness to adopt improved mechanical devices. It was one of the first of the western lines to put in use a steamer on the Mississippi which was large enough to transport a considerable number of loaded cars without breaking bulk, which it did at Quincy, Illinois. During 1866 its gross earnings were $6,175,553, and its net earnings, $2,799,435.

THE CHICAGO, MILWAUKEE AND ST. PAUL,

which now probably owns a larger number of miles of main line than any other railway company, and holds a high rank in the magnitude and success of its operations, is of later origin than its competitors. It was organized by William Wallace Pratt and William H White, purchasers of a portion of the La Crosse and Milwaukee Railroad, on the 5th day of May, 1863, taking the title of the Milwaukee and St. Paul Railway Company, under the revised statutes of the state of Wisconsin of 1858. The name of the company was changed to the Chicago, Milwaukee and St. Paul Railway Company, February 11th, 1874, by a vote of the company, in pursuance of the general laws of Wisconsin relating to railways, passed in 1872. A few important leases and numerous extensions were made, including the acquisition of a line leading from Chicago to the state line of Wisconsin, a distance of 47 miles. Previous to 1870 the relative rank of the company was materially below that which it has since attained.

THE CHICAGO, ROCK ISLAND AND PACIFIC ROAD,

which was the first to connect Chicago with the Mississippi river, was begun in 1852. In 1847 a company was formed under the name of the Rock Island and La Salle Railroad Company, and procured its charter in the same year. Good management has been characteristic of the road since its opening, combined with continual readiness to make advantageous extensions and acquisitions.

In 1851, by an act of the legislature, the name was changed to the Rock Island Company, and it was under that name that the road was constructed between Chicago and Rock Island. In 1866 the road consolidated with another in Iowa called the Chicago, Rock Island and Pacific road, and as its termini and connections were such as to warrant the managers in adopting the name of the road with which it consolidated, this was done. It has been known by that name ever since. At the time the charter was granted Illinois was a border state, Iowa being a territory, but since the border line has been moved further west, the road has contributed vastly to the development of both Illinois and Iowa, as well as other states. Its reward has been a wide reputation and bountiful earnings and profits. There is probably no railway in the west which earns a greater revenue in proportion to its mileage. It is a central line from Chicago westward, passing through fertile portions of Illinois and Iowa, and forming connections which make it a through line to the Pacific coast.

It was one of the first of the roads to bridge the Mississippi, which it crossed at Rock Island, and was one of the earliest of the roads radiating from Chicago to establish a connection with the Union Pacific at Council Bluffs. Its gross earnings during the year ending March 31st, 1866, were $3,154,236 and the net earnings $1,442,781. As the road had land grants which eventually became very valuable, its operations during a large portion of its career have been phenomenally profitable.

THE CHICAGO AND ALTON

is the outgrowth of a corporation chartered in 1847. In 1867 it was in operation between Chicago and St. Louis, forming the most direct line between those cities, and doing a large local business. Its gross earnings in 1866 were $3,840,092, and its net earnings $1,833,517. It was subsequently extended to Kansas City, and has long been noted for the excellence of its management, good condition of its permanent way and rolling stock, and profitableness of its operations. It was one of the first of the Illinois roads to commence relaying its track with steel rails, and probably the first in the world to construct an all-steel bridge, which is located at Glasgow.

The joint effect of these and other lines in developing, benefiting, and enriching the states adjacent to the Mississippi river and north of the Ohio cannot be overestimated. Yet for reasons which are difficult to comprehend one of the most extraordinary popular, legislative, and judicial demonstrations against railway property that has ever occurred was made against them during the early years of the eighth decade.

SUBSTITUTION OF STEEL RAILS FOR IRON RAILS.

THE seventh decade was prolific in railway improvements of various kinds, but there was none which left a more permanent and important impression than the commencement of efforts to substitute steel for iron rails. No other single influence has been equally effective in reducing the cost of transportation and improving the general condition of leading lines. The movement gained a great impetus from a variety of causes, one of which was the relative scarcity, at some periods, of the supply of iron rails, and another the inferiority of many of the iron rails then in use, and consequent necessity of frequent renewal of tracks.

The condition of the iron rail industries of the country during the early portion of the decade is indicated by the following statements:—

CAPACITY OF IRON RAIL MILLS IN 1865.

A letter sent to the Commissioner of Internal Revenue, in 1865, by Samuel J. Reeves, Esq., the chairman of the executive committee of the American Iron and Steel Association, embodied, in a lengthy discussion of proposed changes in the duty on rails, the following statements:—

"1st. That the quantity of railroad iron now being produced in the loyal states is over 275,000 tons per annum, with an ultimate capacity, in the present mills, of double that quantity.

2d. That they are able to keep all the present roads in repair, and furnish a surplus equal to the requirements of nearly 2,000 miles of new track per annum.

3d. That from June 30th, 1861, to June 30th, 1864, all the rails required by the railroad companies, as well as the demand of the United States government for military purposes (with the exception of 206,000 tons imported during the three fiscal years), were supplied by the American mills."

About the same time a table was published giving the names, address, capacity, and production for the year ending November 16th, 1864, of the railroad iron mills of the United States. The total number was 38, capacity 684,000 tons, production 283,560 tons. The capacity of the mills located in Pennsylvania was 291,000 tons, and their production 138,000 tons. The mills that had severally produced 20,000 tons or more, during the year named, were the following: Cambria Iron Company, Johnstown, 40,000 tons; Lackawanna Iron Company, Scranton, 22,000; Pennsylvania Iron Company, Danville, 20,000.

It was announced as a notable event that in the six working days ended March 19th, 1864, the Cambria Iron Company rolled 993 tons of rails, equal to an average of 165½ tons per day.

SIR HENRY BESSEMER'S DESCRIPTION OF THE EARLY TRIALS OF BESSEMER STEEL RAILS.

In 1865 a paper written by Mr. Henry Bessemer, inventor of the Bessemer steel process, was published, in which, after referring at length to the gradual steps by which his process had been improved, and its products applied to various purposes, including locomotive tires and cranks, he gives the following interesting description of the early tests of the value of steel rails:—

"The engineer of the permanent way (of the London and North-western), Mr. Woodhouse, took in hand a thorough investigation of a no less important problem, viz., the substitution of cast-steel for wrought-iron bars. For this purpose some five hundred tons of rails were made, and put down at various stations, where the traffic was considerable, so as to arrive, at the earliest period, at a true comparison of the respective endurance of wrought-iron and cast-steel rails. It will be unnecessary here to enter into the numerous details of the extensive series of experiments systematically carried out by Mr. Woodhouse. The trials made at Camden will suffice to show the extraordinary endurance of steel rails. It is supposed that there is not one spot on any railway in Europe where the amount of traffic equals that at the Chalk Farm bridge at Camden town. At this spot there is a narrow throat in the line, from which converges the whole system of rails employed at the London termini of this great railway. Here all passenger, goods, and coal traffic have to pass. Here, also, the making-up of trains and shunting of carriages is continually going on. At this particular spot two steel rails were fixed on May 2d, 1862, on one side of the line, and two new iron rails were on the same day placed precisely opposite to them, so that no engine or carriage could pass over the iron rails without passing over the steel ones also. When the iron rails became too much worn to be any longer safe for the passage of trains, they were turned the other way upwards, and when the second side of the iron rails was worn as far as the safety of the iron would allow, the worn-out rail was replaced by a new iron one, the same process being repeated as often as was found necessary. Thus we find, at the date of the last report, on March 1st, 1865, that seven rails had been entirely worn out on both faces. Since then another rail has been worn out up to July, making sixteen faces worn out, the seventeenth face being in use on August 22d, when the steel rail that had been placed opposite was taken up in the presence of the writer, and, by the kind permission of Mr. Woodhouse, now lies on the table before the meeting. The first face of the rail only has been used, and this is now become much thinner than it was originally, but, in the opinion of the plate-layers, is still capable of wearing out another half a dozen (iron) faces. Taking its resisting powers at three more faces only, it will show an endurance of twenty to one in favor of steel.

Mr. Woodhouse has ascertained, by careful and continued testing for twenty-four hours at a time, that an average of 8,802 engine tenders or carriages pass over the steel rails every twenty-four hours, equal to 16,164 wheels every day for 1,207 days, making a total of 9,754,974 wheels passed over the rail. Subject to this excessive wear the rail appears to have been reduced 7½ pounds per yard, hence, for every grain in weight of steel lost by abrasion, no less than 371 wheels had to pass over it. Another steel rail, put down also in May, 1862, at a place much less subject to wear, has had four faces of iron rails worn out opposite to it, and still appears as if very little used; this rail is also placed on the table. An iron rail wears out by the giving way at various parts of the imperfectly welded mass, and not by the gradual loss of particles of metal, as in the case of the steel rail, which no amount of wear and tear seems capable of disjointing. It must be borne in mind that this enormous endurance of cast steel is not owing to its hardness or brittleness, as some have supposed, for, in fact, Bessemer steel possesses an extreme degree of toughness. There is before the meeting an example of this fact; one of the same quality of steel rails having been attached at one end to the main driving shaft of a steam engine so as to twist it while cold into a long spiral, measuring 9 feet in length at top and bottom, and only 6 feet if measured along the centre of the web. A single glance at this spiral rail will, it is presumed, dispel any idea of brittleness that may have been entertained."

AMERICAN RECOGNITION OF THE UTILITY OF STEEL RAILS.

Facts like those cited above naturally attracted the attention of astute American railway managers, and their views are partly indicated by the following statements:—

The Canada Grand Trunk Railway report for 1863 says that "arrangements are in progress for the manufacture, under contract, of steel and steel-headed rails, to be laid down in place of iron rails on the main line; and the information and reports which the board have received confirm their previous impression of the greatly superior endurance of the proposed new material. The proved results on the London and North-western line afford most valuable evidence; it has in fact, been found, as stated by the chairman of the London and North-western company at their recent half-yearly meeting, that the new rails laid down on the busiest portions of their line have already lasted ten times as long as the ordinary iron rails."

The Pennsylvania Railroad annual report, dated February 15th, 1864, says:—

"The rapid destruction of iron under the high speeds and heavy locomotives now used upon railways has become a subject of serious consideration, not only to the managers of these improvements in this country, but also in Europe. When the Pennsylvania Railroad was planned a locomotive weighing from 45,000 to 50,000 pounds was considered as the extreme limit of these machines, justified by prudence. But the demands of the public for high speeds has compelled the introduction upon all thoroughfares of more powerful engines. These could only be obtained by adding to their dimensions and weight, which has produced its natural result—great wear and tear of iron rails, and the superstructure of the road. This evil has been still further increased by the inferiority of the rails now manufactured, compared with those placed upon railways when the edge-rail was first introduced. It was then deemed essential that rails should be made from the best refined iron produced from selected ores. The great increase in the demand for iron under the rapid development of the railway system in England and this country soon caused the substitution of an inferior article, which seemed for a time to answer the purpose, but which experience has proven to be insufficient to resist the causes referred to as continually operating for its destruction. A return to the quality of the iron originally used on railways would be the natural remedy for this difficulty, but this would require time, as none of the rail mills have the required furnaces to refine their metal. In Europe this subject has been longer considered, and the determination appears to be general to gradually substitute a still more expensive material, either a rail made wholly of steel, with a steel head only, or the wearing surface converted into steel after the iron rail is made. The present high cost of rails made entirely of steel will probably prevent their general adoption, although the rapid destruction at the termini and stations, where the iron rail in some positions does not last six months, will fully justify their introduction. For the purpose of testing the relative value of steel and iron rails in such positions, we have procured 150 tons of rails made wholly of cast steel. A trial is also being made of a rail with a steeled wearing surface passed through the rolls, when drawn from the converting furnace, which promises well. It is understood that favorable results have been obtained from rails, the top plate in the pile from which they were made being puddled steel. If the two metals can thus be firmly welded together, this improvement in railway bars will be generally adopted. This is a subject of such great importance to the company that it will continue to meet the earnest attention of your directors, and, if necessary to effect the reformation desired in the quality of rails, it should become important to erect works to effect that object, such a policy will be adopted. The frequent renewal of rails is not only expensive, but it adds to the interruption of the traffic of the line."

The Pennsylvania Railroad report for 1864, dated February 18th, 1865, says: "Notwithstanding our unremitting efforts to secure the best rails that are made, each succeeding year adds its testimony to those preceding it of the want of a better material than that now used. In addition to their rapid destruction from ordinary wear, is added the risk to the trains from their frequent breakage. To obviate this our new rails have been increased in depth to an extent (4½ inches) that will give them 30 per cent. additional vertical strength, which it is believed will, with increased care in the selection of ores and the manufacture of the rails, prevent further damage from this source. The steel rails introduced upon the road show no evidence of wear, but their great cost at present precludes their general introduction. The manufacture of rails with a steeled-wearing surface, referred to in our last annual report, has not proved successful upon a scale that would render it of practical value."

RESULTS OF EXPERIMENTS ON THE PENNSYLVANIA RAILROAD.

Two years later, describing operations of the Pennsylvania Railroad Company, for the year 1866, president Thomson in his report dated February 19th, 1867, says: "Every effort to materially improve the quality of the iron to meet the wants of the augmenting traffic of the trunk lines, having heretofore failed, attention was directed to the introduction of steel rails, and, with a view to test their efficiency, the president, while in England, in 1862, ordered a few hundred tons for trial. These proved so satisfactory that larger importations of Bessemer steel have been made, which entirely confirmed our expectations of their success. The cost of steel rails is at present about twice that of the best iron rails, while their durability is fully eight times greater. It is confidently believed, however, that with enlarged works, increased knowledge of the ores required to produce the best quality of this metal, and great experience in its production, they will be successfully manufactured at home, and the price very largely reduced. At present the demand is equal to the supply, and prices are maintained. To avoid the heavy annual outlays, that a change from a cheap to a dearer material would necessarily entail upon the revenues, it is proposed to continue for the present to reroll the worn-out rails, and replace the annual wear and tear with steel rails. The general introduction of steel rails is now wholly a commercial question, in which the cost of the increased capital required for their purchase becomes the chief impediment to their general adoption. While the business of a line is small, it will still be economy to use the iron rails, at an ordinary rate of interest upon capital until the cost of producing steel is reduced to its minimum. When that result is accomplished the general public will be materially benefited by the reduced cost of transportation which the introduction of steel rails will enable railway companies to afford."

IRON AND STEEL RAILS ON THE ERIE RAILWAY.

In a letter written by H. Riddle, general superintendent of the Erie Railway, to John S. Eldridge, president of that road, dated March 3d, 1868, he states that during the preceding three winter months "the iron rails have been broken, laminated, and worn out beyond all precedent, until there is scarce a mile of your road, except that laid with steel rails, between Jersey City and Salamanca or Buffalo, where it is safe to run a train at the ordinary passenger-train speed, and many portions of the road can only be traversed safely by reducing the speed of all trains to twelve or fifteen miles per hour, solely on account of the worn-out and rotten condition of the rails. Broken wheels, axles, engines, and trains off the track have been of daily, almost hourly, occurrence for the last two months, caused mostly by defective rails. Fully one thousand *broken rails* were taken from the track in the month of January, while the number removed on account of lamination, crushing, or wearing out was much greater. February will show a worse record than January. . . . With the ten miles laid with the John Brown Bessemer steel no fault need be found. Only one rail has broken during the winter, and no lamination and very little wear is perceptible. Twenty steel rails were laid in Jersey City yard last March. The iron rails adjoining, subject to the same wear, have been renewed four times since the steel was put down, and I have no doubt the steel rails will outlast three times as many more iron rails. This winter's experience has satisfied me that the quality and weight of the iron rails in use cannot be depended upon to sustain the weight of the Erie Railway. Forty-two-ton locomotives, hauling trains of fifty and sixty loaded cars, and passenger engines weighing thirty-seven tons, running at a speed of thirty to forty miles per hour, literally crush and grind out the iron rails beneath them. Instances have been reported to me of rails removed from track, too much worn for safety, where the first imperfection was visible but the day before."

PRODUCTION OF AMERICAN STEEL RAILS.

VIEWS similar to those announced in the extracts printed above were entertained in a number of advanced railway circles, and corresponding action was taken. A number of experimental trials were made, with satisfactory results, but the price of steel rails was an insurmountable obstacle to their general introduction before Bessemer steel works were established in this country.

FIRST STEEL RAILS MANUFACTURED IN THE UNITED STATES.

It is claimed that the first steel rail rolled in America was made at the Chicago Rolling Mill, under the direction of W. F. Durfee, engineer, on May 25th, 1865. The ingots used had previously been manufactured at the Wyandotte Rolling Mill, located at Wyandotte, Michigan, in accordance with the Kelley process, an American patented invention, which conflicted with the claims based on the Bessemer patent to an extent that presumably led to a postponement of the active operations subsequently undertaken until these antagonisms were reconciled. The following contemporaneous announcement was made in a letter forwarded to W. F. Durfee:—

S. CLEMENT, President. E. B. WARD, Treasurer. O. W. POTTER, Sec. and Gen. Sup't.

OFFICE OF THE CHICAGO ROLLING MILL,
16 and 18 River Street, Chicago, May 26th, 1865.

MY DEAR DURFEE: The meeting of the iron and steel men adjourned yesterday to meet in Cleveland the fourth Wednesday in August. I regret very much you could not have been here, particularly to see how well your steel behaved, and you must allow me to congratulate you upon its entire success, and I assure you I was but too proud for your sake that everything *we* had to do with it proved so very successful. The hammer was altogether too light, of course, and it took more time than it otherwise would to draw the ingot down, yet all the pieces worked beautifully, and we have made six good rails from the ingots sent over, and not one bad one in any respect. The piece you sent over forged is now lying *in state* at the Tremont House, and is really a beautiful rail, and has been presented to the Sanitary Fair by Captain Ward. We rolled three rails on Wednesday and three on Thursday. At the first rolling only your cousin and George Fritz were present; at the rolling yesterday were senator Howe, of Wisconsin; B. F. Jones, of Pittsburgh; R. H. Lamborn, of Philadelphia; Mr. Phillips, of Cincinnati; Mr. Swift, of Cincinnati; Mr. Kennedy, of Cincinnati; Mr. May, of Milwaukee and three ladies; Mr. Scofield, of Milwaukee; Mr. Fritz, of Johnstown; and Mr. Thomas, of Indianapolis, with four strangers. Everything went so well I really wanted you to see some of the good of your labors for so long a time and under such trying circumstances. You have done what you set out to do, and done it well, and I am glad to congratulate you and rejoice with you, for I can appreciate some of your difficulties, and wanted you to hear some of the praises bestowed upon your labors as you richly deserve. I know this would make no sort of difference to you, and yet we all have vanity enough (especially in such cases as this) to feel gratified at any little compliments we know we are entitled to, but I will not tire you with any more, as your cousin [the late Z. S. Durfee] can tell you all and more than I can write, but with kindest regards allow me to remain,

Yours most obt., O. W. POTTER.

ORGANIZATION OF THE EARLY AMERICAN STEEL-RAIL INDUSTRIES.

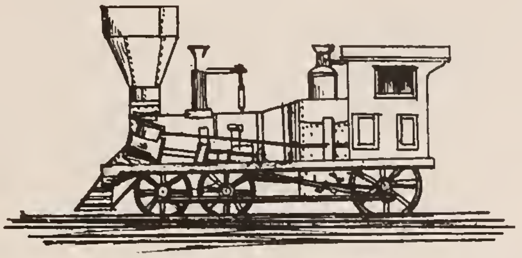
In 1882, in a letter addressed to Judge Kelley, Mr. James M. Swank gave the following account of the organization of the early steel-rail works of this country:—

"Each of the two experimental Bessemer steel works which were established in this country in 1864 and 1865, one at Wyandotte, Michigan, and the other at Troy, New York, lost money. The Wyandotte works were abandoned in 1869, and were almost a total loss. The Troy experimental works were succeeded in 1867 by permanent works, and these were burned in 1868. New works were completed in 1870, and it was not until after this event that any money was made in the manufacture of Bessemer steel at Troy.

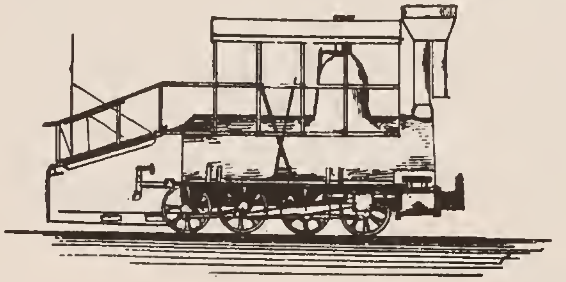
The first works established in Pennsylvania expressly to manufacture Bessemer steel were those of the Pennsylvania Steel Company, near Harrisburg, which were commenced in 1865. In 1867 steel was first manufactured at these works, since which time they have been steadily in operation. But it was not until 1873, eight years after the erection of the works had been undertaken, that a cash dividend was declared, and then it amounted to only two per cent. upon the capital stock. At this time the stock exceeded one and three-quarter million dollars. A short time prior to this dividend one of the stockholders sold his stock for one-half its original value.

The second Bessemer steel works in Pennsylvania were those of the Freedom Iron and Steel Company, near Lewistown. They were undertaken in 1866. In 1868 they commenced to make steel, and in 1869 the company failed, and the works were subsequently dismantled. Over one and a half million dollars, in capital and bonded and unbonded debts, was sunk in this abortive enterprise.

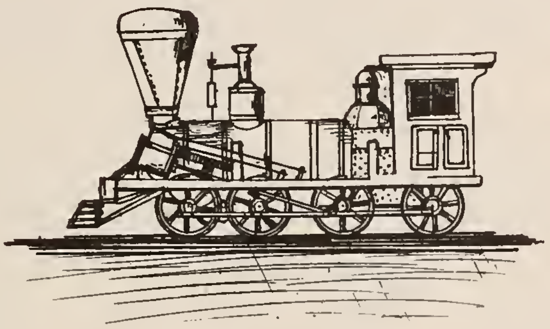
The Cambria Iron Company, at Johnstown, Pennsylvania, has manufactured Bessemer steel since 1871, but it was originally organized in 1853 to manufacture iron rails. Its capital stock was one million dollars. In 1854 the company failed, and in 1855, fresh capital having been added, it failed again. The works were then leased. In 1861 the company was reorganized, and placed upon a firm financial basis, the original stockholders, who had paid a million dollars, surrendering their stock, and receiving in exchange one hundred thousand dol-



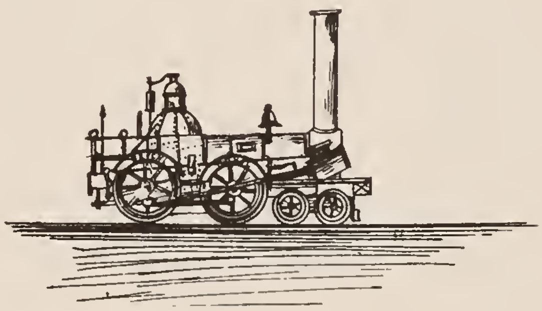
Baldwin's Six-Wheel Connected Engine, 1843.



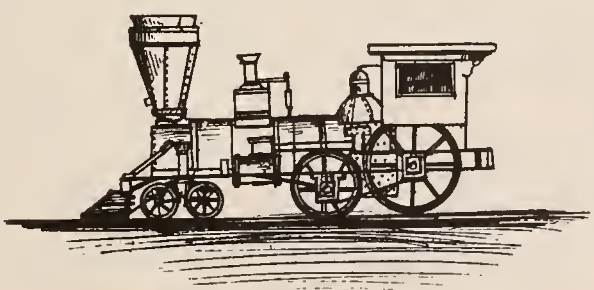
Winan's "Camel" Engine.



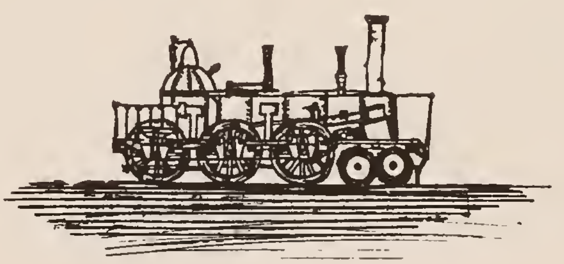
Baldwin's Eight-Wheeled Engine, 1845.



Rogers' Engine, 1844.



Baldwin's Fast Passenger Engine, 1848.



Rogers' Ten-Wheeled Engine, 1848.

IMPROVEMENTS IN LOCOMOTIVES
FROM 1840 TO 1850.

lars of new stock, or one hundred dollars for every thousand dollars they had invested. Thus the original promoters of this enterprise absolutely lost nine hundred thousand dollars.

The Bethlehem Iron Company, at Bethlehem, Pennsylvania, was organized in 1863 to manufacture iron rails, and in 1873 it commenced also to manufacture Bessemer steel. It has continued the manufacture of Bessemer steel until the present time. From 1869 to 1873 only stock dividends were made, and from 1873 to 1879 neither stock nor cash dividends were declared. In these latter years the company's operations were conducted at an actual loss. In 1874 a bonded debt of a million dollars was created, and in 1877 additional bonds were issued to the amount of $278,000.

The effort to establish the Bessemer steel industry in the west has been attended with many discouraging vicissitudes. The works of the Joliet Iron and Steel Company, at Joliet, Illinois, were commenced in 1870, and in 1873 they first manufactured Bessemer steel. In 1874 the company failed, and the works were stopped. The company made another effort to achieve success, but after a long struggle again failed, but not until fresh debts had been created, the whole investment aggregating three million seven huhdred thousand dollars. After passing through bankruptcy, the works were sold in 1879 for a sum not sufficient to pay all the bondholders, and the original capital was lost. The works of the Vulcan Steel Company, at St. Louis, Missouri, were built in 1872 to roll iron rails, but in 1875 the company commenced the erection of Bessemer steel works. In 1876 these works were completed, and steel was made by them in that year. Soon afterwards the company failed to meet its obligations, and the works were stopped, but, after many serious losses, it has been reorganized, and the works are now in operation. Probably two million dollars has been expended in building up this enterprise, which has until very recently been exceedingly unprofitable."

PROGRESS IN AMERICAN STEEL-RAIL-MAKING.

The following table shows the annual production in gross tons of Bessemer steel rails in the United States since the beginning of their manufacture in 1867, together with the average annual price at which they have been sold at works in Pennsylvania and the rates of duty imposed on foreign rails:—

Years.	Production in gross tons.	Price in currency.	Duty.
1867	2,277	$166 00	45 per cent. *ad valorem.*
1868	6,451	158 50	
1869	8,616	132 25	
1870	30 357	106 75	
1871	34,152	102 50	$28 per ton to Aug. 1st, 1872; $25.20 to Mar. 3d, 1875; $28 from that date to July 1st, 1883.
1872	83,991	112 00	
1873	115,192	120 50	
1874	129,414	94 25	
1875	259,699	68 75	
1876	368,269	59 25	
1877	385,865	45 50	
1878	491,427	42 25	
1879	610,682	48 25	
1880	852,196	67 50	
1881	1,187,770	61 13	
1882	1,284,067	48 50	
1883	1,148,709	37 75	$17 per ton from July 1st, 1883.
1884	996,983	30 75	
1885	959,471	28 50	
1886	1,574,703	34 50	
1887 (March)	......	39 50	

The lowest average annual price at which Bessemer steel rails have been sold in this country was reached in 1885, namely, $28.50, but sales were made at still lower figures in both 1884 and 1885.

The outlays for steel rails, which commenced in the seventh decade, continued to represent a large expenditure on account of increase in the quantity used, which was generally accompanied by a large annual decrease in price per ton, except during years when unusually large amounts of new railway construction were progressing. It was estimated in 1885 that up to that year 10,000,000 tons of steel rails had been produced in this country, of which less than 50,000 tons had been made before July, 1870, and the price had fallen from $106.75 per ton in 1870 to such an extent that sales were reported in 1885 at less than $30 per ton, or $28.50 at the mills.

The limited product of rails in American Bessemer mills before 1871 indicates that the works of this country before that time had only been making preparatory efforts for the gigantic labors they subsequently performed.

TABLE SHOWING THE PRODUCTION, IMPORTATION, CONSUMPTION, AND PRICE OF RAILS IN THE UNITED STATES FROM 1860 TO 1880, WITH THE MILEAGE OF RAILROAD BUILT.

Year.	Production. Iron.	Production. Steel.	Production. Total.	Imports.* Iron.	Imports.* Steel.	Apparent consumption.†	Miles of railroad built.	Average price of iron rails.	Average price of steel rails.
1860	205,038	......	205,038	139,835		341,873	1,846	48	....
1861	189,818	......	189,818	83,429		273,247	651	42⅜	....
1862	213,912	......	213,912	9,644		223,556	834	41¾	....
1863	275,768	......	275,768	19,138		294,906	1,050	76⅞	....
1864	335,369	......	335,369	132,959		468,328	738	126	....
1865	356,292	......	356,292	86,820		443,112	1,177	98⅝	....
1886	430,778	......	430,778	87,368		518,146	1,742	86¾	....
1867	459,558	2,550	462,108	163,049		625,157	2,449	83⅛	....
1868	499,489	7,225	506,714	250,081		756,795	2,979	78⅞	158½
1869	583,936	9,650	593,586	313,163		906,749	4,953	77¼	132¼
1870	586,000	34,000	620,000	399,153		1,019,153	5,690	72¼	106¾
1871	737,483	38,250	775,733	566,202		1,311,935	7,670	70⅜	102½
1872	905,930	94,070	1,000,000	381,064	149,786	1,530,850	6,167	85⅛	112
1873	761,062	129,015	890,077	99,201	159,571	1,148,849	4,105	76⅝	120½
1874	584,469	144,944	729,413	7,796	100,515	837,724	1,901	58¾	94¼
1875	501,649	290,863	792.512	1,174	18,274	811,960	1,917	47¾	68¾
1876	467,168	412,461	879,629	287	.....	879,916	2,856	41¼	59¼
1877	332,540	432,169	764,709	.....	35	764,744	2,281	35¼	45½
1878	322,890	559,795	882,685	.....	10	882,695	2,687	33¾	42½
1879	420,160	693,113	1,113,273	19,090	25,057	1,157,420	4,721	41¼	48¼
1880	493,762	968,075	1,461,837	132,459	158,230	1,752,526	7,174	49¾	67½

* Fiscal year to 1867. † Including imports per fiscal year to 1867.

TABLE SHOWING THE NUMBER OF MILES OF TRACK LAID WITH STEEL OR IRON RAILS, BY GEOGRAPHICAL GROUPS, IN THE UNITED STATES, ON JUNE 30, 1880.

Metal.	Miles in group I.	Miles in group II.	Miles in group III.	Miles in group IV.	Miles in group V.	Miles in group VI.	Aggregate miles in U. S.
Steel.	2,936.11	17,004.74	3,645 04	9,539.13	132.00	4,070.86	37,328.78
Iron.	5,166.58	23,470.31	11,926 92	16,775.20	892.40	12,509.72	70,741.13
Aggregate.	8,102.69	40,475 05	15,571.96	26,314.33	1,025.30	16,580.58	108,069.91
Per ct. steel.	36	42	23	6	..	25	35
Per ct. iron.	64	58	77	94	..	75	65

In regard to the progress of the change from iron to steel rails in various sections it is stated that steel rails appear to have been first laid in this country in 1864, when three companies in the Middle states used them to a limited extent, and four companies in the New England states. One company in the central Western states commenced using steel rails in 1865, and subsequently one company in the southern and western trans-Mississippi states and territories commenced using them in each of the years 1870, 1872, and 1878.

Of the 1,174 companies owning roads in 1880, 522, or nearly 45 per cent., had in that year laid steel rails on either a portion or the whole length of their roads. Of these companies the lines of 65 were located in group I, 269 in group II, 60 in group III, 79 in group IV, 3 in group V, and 46 in group VI.

BRIDGE CONSTRUCTION.

AN unusual amount of bridge construction was necessary during the war period, mainly on account of the frequency with which bridges were destroyed by hostile armies, but also partly on account of the desire to facilitate travel on important routes which had previously used ferries at points where expensive bridges were finally erected. An intense desire to improve the links by which different communities were connected, and to abridge distance, was manifested in many quarters, and one of its outgrowths was a notable increase in the number of new bridges, and improvements in the methods of their erection and construction, intermingled with a disposition to substitute iron for wood bridges. The general course of events is indicated by the following statements, although they necessarily embrace references to only a small proportion of the bridge construction of the decade:—

Of bridges on the Northern Central, it was stated that Confederate raids in 1863 and 1864 destroyed thirty-four, all of which had been substantially rebuilt, in most instances with structures of stone and iron.

The report of the Baltimore and Ohio for 1862, after referring to the injuries inflicted upon the line by Confederate raids, says: "The board having determined to replace the numerous wood-and-iron and wooden bridges, which have been destroyed in the progress of the war, with iron structures of the most substantial material and improved description, the material was promptly secured, and a considerable portion of the work has been successfully accomplished in the shops of the company."

One of the war bridge feats reported in 1864, credited to the construction corps of the United States military railroads, was the rebuilding, in four days and a half, of a railroad bridge over the Chattahoochie, 760 feet long and 90 feet high, which had been destroyed by Confederates in their retreat.

OBJECTIONABLE FEATURES OF WOODEN BRIDGES.

A correspondent of the New York Evening Post, writing on July 7th, 1864, of the bridges of the old style then usually met on railway lines, complained that they were nearly all wooden bridges, and said:—

"You are riding along in a railroad car enjoying the scenery. A river gleams ahead. You approach its banks and prepare to catch expected glimpses of beauty up or down the stream. But suddenly a roaring sound is heard. You plunge into a great wooden tunnel; wooden walls on either side hide the view; a wooden roof blocks out the light of day. After a minute of deafening noise you emerge, but the river is crossed, the stream is passed, and the delicious bit of scenery is lost to you. The vast majority of bridges in this country, whether for railroads or for ordinary horse travel, have these elemental points:—

1. Fragility. 2. Unendurably hideous ugliness. 3. Great aptitude for catching fire.

They are all built of wood, and must be constantly patched and mended, and will rot away in a very few years. They are enormous blots on the landscape stretching as they do like long unpainted boxes across the stream; like huge Saurian monsters with ever open jaws into which you rush, or walk, or drive, and are gobbled up for all sight or sense of beauty. The dry timber of which they are built will catch fire from the mere spark of a locomotive, as in the case of that hideous bridge which had so long insulted the Hudson river at Troy; and which was not only burned itself but spread the destroying flame to the best part of the town.

These bridges deface all the valleys of our land. The Housatonic, the Mohawk, the Lehigh, the hundreds of small yet beautiful rivers which so delightfully diversify our country, one and all suffer by the vile wooden bridge system which has nothing at all to plead in extenuation of its tasteless, expensive existence.

Every bridge in this country should be deprived of its heavy roof; and if the exigencies of engineering required side walls, they should be plentifully perforated with open spaces. The more recent railroad bridges are fortunately open bridges, or 'viaducts,' as it is fashionable to call them, and the traveler, as in the case of the Starucca viaduct on the Erie road, can both admire the engineering skill and enjoy the scenery."

NEW BRIDGES OF THE DECADE.

One of the important new railway bridges of the decade was built by the Philadelphia, Wilmington and Baltimore across the Susquehanna, between Perryville and Havre de Grace. It was reported at the time that notable improvements in methods for establishing a foundation were adopted. The bridge was reported to be 3,300 feet long.

Of the Connecting Railroad bridge, built over the Schuylkill, near Girard avenue, in Philadelphia, it was said in 1864, when the work was progressing, that "the piers will rest on foundations laid on solid rock. An iron section of 270 feet span will arch the channel. To this iron section, which is being built in the Altoona shops of the Pennsylvania Railroad Company, (the Pennsylvania Railroad Company build all their own iron bridges in their own shops), the iron will be carried on marine brick arches of 60-feet span."

The Baltimore and Ohio report for 1865 says: "Since the destruction of the wooden and other bridges upon its line during the war, twelve first-class iron bridges, aggregating three thousand and seventy-five feet, with twenty-seven spans, varying from seventy-eight to two hundred and five feet in length, and of a very costly character, have been built at the Mount Clare workshops, placed upon superior masonry, and are now in successful use."

In connection with the reconstruction of a bridge on the line of the Memphis and Charleston, at Decatur, more than 1,700 feet long, which had been destroyed during the war, it was stated that a contract was made in October, 1865, with Albert Fink, of Louisville, Kentucky, who then had a wide reputation as the inventor of a useful truss bridge, and as an experienced and reliable bridge-builder, and that it was completed so that trains passed over it on July 7th, 1866. It was reported to be "a first-class bridge, of the Fink V patent, with wrought-iron bottom chords, and wooden top chords covered with tin, and wooden braces so arranged that any one of them can be removed without interruption to passing trains, combining probably more strength, durability, and economy than any other bridge, and with less liability to accident than any bridge except those built of iron."

BRIDGE OVER THE MONONGAHELA.

One of the notable bridges of the decade was constructed over the Monongahela river, at Pittsburgh, to facilitate movements on western connections of the Pennsylvania Railroad. The following description of it was published in the Pittsburgh Chronicle, of September 21st, 1865:—

"The river is spanned by five trusses of wood, each 187 feet in length, and one iron span 260 feet in length, for double track, over the channel. The wooden spans have a double series of braces, supported on Piper's improved bearing blocks. The roadway passes over the wooden spans, and through the iron bridge, affording at the channel a clear headway of about 60 feet from low water. This span is 23 feet in clear width, and 28 feet in heighth, and will sustain safely two tons per foot. The bridge was constructed from the same patterns used for the structure over the channel at Steubenville. The designs appear both novel and original. Each truss is double and combined to give greater lateral stability, so essential in great spans. The combination posts are trussed, avoiding the necessity of using heavy columns. The tension chains each consist of light wide-eye bars, with 'upset' ends, linked together by connecting pins four and a half inches in diameter. In this system the entire strength of the material is economized without carrying any useless weight. This structure presents a light and graceful appearance, while its immense strength may be inferred from the fact that 100 tons of bolts, more than 90 tons of chord links, and 300 tons of castings, all of approved quality, have been judiciously employed in its construction. This span is constructed according to the patents of Linnville and Piper."

PROGRESS IN BRIDGE CONSTRUCTION.

Many changes were progressing during the seventh decade in the bridges of the important railways of the Middle states, partly because the old structures needed repairs, replacement, or strengthening, and partly because improved methods of construction were devised, and experience had suggested the desirability of a substitution of wrought iron for various purposes for which cast iron had previously been used. On the main line of the Pennsylvania Railroad, west of Altoona, iron bridges had been erected between 1851 and 1853, when the road had been first constructed, which were deck bridges, having the track on top. They were based on the Pratt principle, having cast-iron upper chords, cast-iron vertical posts, and wrought-iron lower chords, inclined ties and counters. A cast-iron arch was also introduced, which was added as an extra precaution. Bridges of a similar type, with various improvements in detail, were introduced during the next ten to twelve years to take the place of wooden bridges originally erected on eastern parts of the road. After traffic had greatly increased, and material additions had been made to the weight of locomotives, it was considered prudent, about 1868–69, to replace some of the oldest iron bridges with new structures. At the same time, solid rolled I beams of various depths were used for bridges of small spans, from ten to twenty feet. In 1865 the department of bridges and buildings on the Pennsylvania Railroad passed into the charge of Joseph M. Wilson, and under his direction important modifications of the plans previously in use were soon devised, and subsequently applied to the new bridges erected.

DRAW BRIDGE OVER THE MISSISSIPPI.

A new bridge (draw bridge) constructed by the Chicago and North-western and reported to be the second bridge over the Mississippi river below St. Paul, was built over the Mississippi at Clinton, Iowa, early in January, 1865, of which the following description was published about the time of its completion: "The total length of the bridge as built is 3,650 feet. Of this distance 2,800 feet is between the Illinois shore and Little Rock Island and 850 feet is between Little Rock Island and the Iowa shore. The bridge east of Little Rock Island consists of 1,400 feet of piling and seven spans of 200 feet each of McCallum's patent truss. The truss bridges rest upon piers and abutments of masonry founded on piles. West of Little Rock Island the bridge consists of three spans of the Howe truss bridge, beside the draw.

Two spans of the Howe bridge are 175 feet long each, and one span 200 feet long. The draw is 300 feet long over all, and is built of iron. The abutments and one of the piers are founded on rock, a second pier is founded on piles, and a third pier and the draw pier are built upon crib work, resting on loose sand. These cribs are sunk in water 40 feet deep. The large crib is 400 feet long and 44 feet wide, and the smaller is 160 feet long and 44 feet wide at the bottom. The masonry is of the most substantial description, and is built of Athens stone. The draw turns on a pivot in the centre, and when open leaves two clear passage ways for steamboats, 123 feet each.

In that part of the bridge between Little Rock Island and the Iowa shore, there was used in the two cribs about two million feet of timber, 50,000 cubic feet of dimension stone from the Athens quarries, and about 600,000 cubic feet of rubble stone, from quarries near Clinton. All intersections of timber in the cribs are secured with oak trenais, of which about ten miles in length were used. The iron draw weighs about 325 tons, and is an admirable piece of workmanship. The ends, when being swung, are supported by iron rods, which pass over the tops of the centre towers. When it is desired to turn the bridge the ends are lifted from off their piers by means of a hydraulic press, which lifts the caps of the central tower through which the main suspension rods pass, and then the bridge is turned by a steam engine, standing on the upper chord. Arrangements are also made whereby the bridge can be turned by hand, if necessary. The work of construction was commenced in January, 1864, and the first train crossed January 6th, 1865."

OTHER BRIDGES CROSSING THE MISSISSIPPI.

After two iron bridges had been thrown across the Mississippi, one by the Chicago, Rock Island and Pacific, during the fifth decade, and the other by the Chicago and North-western, during the sixth decade, it was inevitable that a number of other companies owning or interested in lines on both sides of that river should erect bridges as speedily as possible. Some of these new bridges were finished during the seventh decade, and the completion of others, like the famous bridge at St. Louis, postponed to a later period.

The report of the Toledo, Wabash and Western, which subsequently became part of the Wabash, St. Louis and Pacific, for 1866 stated that it was then engaged in the construction of an iron railroad bridge across the Mississippi river at Quincy, which it expected to have ready for the passage of trains before the close of 1867, and that it had also contracted for the construction of another railroad bridge across the Mississippi river at Keokuk.

A correspondent of the New York Express, who was presumably Hon. James Brooks, an editor and proprietor of that journal, in describing a jonrney made westward in 1867, said: "Chicago was left between 10 and 11 A. M., and by 3 or 4 we were on the bridge over the Mississippi at Clinton. The great Father of Waters—think of it—now has to consent to be shackled by bridges and locomotives and cars. The common law made him a monarch of waters, but the locomotive now repeals and reverses such common laws. Water here is no match for fire. The boatmen growl, the raftsmen swear, but on strides the locomotive, from bank to bank, over mast and pipe, with an utter recklessness of all the craft below it. The Missouri is to be everywhere bridged, as well as the Mississippi, for trade runs east and west—and what trade wills the laws obey—while the great waters of the west will soon be left only to the heavy freights of the common boatmen."

BRIDGING THE OHIO, MISSISSIPPI, AND MISSOURI.

THE entire subject of erecting railway bridges over navigable waters assumed a new aspect during the seventh decade, on account of the development of an imperative necessity for improving the channels of communication between the states east and west of the Mississippi and Missouri rivers, and the states north and south of the Ohio, and congressional action, which gave a more distinct and emphatic authorization of bridge projects than had previously been procured.

CONFLICT OF RAIL AND RIVER INTERESTS.

Bitter controversies had grown up between representatives of overland and river interests, on account of obstructions to navigation which had been created by a highway draw-bridge over the Ohio at Wheeling, and the railway draw-bridge erected over the Mississippi, between Rock Island and Davenport, without congressional authority. Under the old system, few companies cared to undertake the construction of bridges over either of the great western rivers at any point, and no legal sanction for snch enterprises was deemed necessary except such as could be procured from state legislatures. The modern usage, when navigable streams form a boundary line between states, is to require congressional sanction for the bridges erected over them, which is sometimes supplemented by favorable action of both the states interested.

The first series of

CONGRESSIONAL BRIDGE LAWS

of material significance were passed during the seventh decade. They were based on the theory that railway bridges might be built at the points named in the various enactments, provided a design and style of construction was adopted which would avoid serious obstructions to navigation. This exception left a large field for controversy, as the navigable interests included not only steamboats, some of which formerly had pilot houses and chimneys at a great height above the water, but also tows of barges and large rafts which required for their successful operation a wide distance between piers. The steamboat men claimed that high chimneys were of great service, for the double purpose of giving draught, and either cooling sparks as they ascended to great heights, or preventing them from engendering fires as they fell on decks. One steamboat, the James Howard, built for service on the lower Mississippi in 1874, which had no bridges to encounter, had chimneys 104 feet above the water, and it was reported that the chimneys of the Great Republic reached a still higher altitude. The general range of the height of chimneys on the large Mississippi river boats, which formerly passed St. Louis, was from 65 to a little more than 90 feet; and the top of their pilot houses was from 46 to 69 feet above water. As the waters of the western rivers occasionally rise many feet above the normal standard, and it was necessary that provision should be made for operations during high-water periods, it is obvious that it would be exceedingly difficult, or practically impossible, to construct bridges at a number of points where they were desirable which would not obstruct the passage of boats having chimneys 100 feet high, unless they were draw-bridges. The advocates of bridges insisted that excessively high chimneys were not absolutely necessary, and important concessions relating to the height of bridges were obtained.

Other difficulties arose out of the requirements of the barge system for a wide space between the piers of any bridge that might be erected. At the time the bridging of the Ohio at Steubenville was authorized, in 1862, the barge system or combinations of flats and barges used in the transportation of coal had come into such extensive use on the Ohio that a congressional enactment required a width of not less than 300 feet in the clear between piers, and the coal navigation interests endeavored to secure a space of not less than 500 feet. Subsequent laws of Congress require spans of not less than 400 feet in the clear on the Ohio below the mouth of the Big Sandy river, and bridges across the Ohio giving a clear span of 500 feet were built. A wide space between spans was peculiarly desirable on the Ohio on account of the magnitude of the coal tows on that river.

On the Upper Mississippi the rafting interest was formerly very important, and on that account, as well as on account of the demands of steamboat interests, a wide space between piers was considered desirable, but the characteristics of that stream at many points are deemed unusually favorable for bridging, in comparison with other rivers of equal magnitude, and especially the Missouri.

Supervision over the erection of bridges across navigable waters, in accordance with acts of Congress, was commenced by the United States engineers in the seventh decade, and has been continued since, and their views or recommendations have exercised an important but not always a controlling, influence over the final decision of the numerous disputes between representatives of conflicting rail and river interests which have arisen.

RAILWAY BRIDGES AUTHORIZED BY CONGRESS IN THE SEVENTH DECADE.

The list of bridges over navigable waters authorized by Congress during the seventh decade, or in early years of the eighth decade, the building of which bridges was generally, but not in all instances, commenced soon after their construction was authorized, and which were usually, but not always, railway bridges, or combinations of railway and highway bridges, included bridge structures subject to various restrictions and requirements at or near each of the points named below:—

Over the Ohio River.—At Steubenville, or any point above the mouth of the Big Sandy river; between Cincinnati, Ohio, and Covington, Kentucky; at Louisville, Kentucky; Wheeling, West Virginia.

Over the Mississippi River.—At Quincy, Illinois; Burlington, Iowa; Prairie du Chien, Wisconsin; Keokuk, Iowa; Winona, Minnesota; Dubuque, Iowa; St. Louis, Missouri; Clinton, Iowa; Rock Island, Iowa (as a substitute for the bridge first erected by the Chicago and Rock Island Railroad Company); La Crosse, Wisconsin; Muscatine, Iowa; at any point between the counties of Whitesides and Carroll, Illinois, and Jackson and Clinton, Iowa; Hudson, Wisconsin; Warsaw, Illinois; Fort Madison, Iowa; Red Wing, Minnesota; Lexington, Missouri.

Over the Missouri River.—At any point necessary for convenience by the Union Pacific and Hannibal and St. Joseph railway companies; at Kansas City; Fort Leavenworth, Kansas; St. Joseph, Missouri; Omaha, Nebraska; Louisiana, Missouri; Glasgow, Missouri; Boonville, Missouri; Nebraska City, Nebraska; Brownville, Nebraska; Sioux City, Iowa.

The authorization of additional bridge structures over the navigable waters named above, and other streams, has since formed an important portion of the labors of a number of sessions of Congress.

THE SPECIFIC RESTRICTIONS AND REQUIREMENTS IMPOSED BY CONGRESS,

in connection with the grants of authority to construct bridges, have varied materially, on account of the differences in the requirements of river interests at various points, or other causes.

The leading provisions of an act passed in 1866 authorizing the construction of eight bridges on the Mississippi and one on the Missouri were that if built as high bridges they should be 50 feet above extreme high-water mark, with spans not less than 250 feet in length, and one main or channel span not less than 300 feet in length. If built as draw-bridges, they should have two draw openings of not less than 160 feet in the clear, and next adjoining spans of not less than 250 feet, and should be 10 feet above high-water mark, and at least 30 feet above low-water mark. Provisions similar to those enumerated above were applied to a number of bridges over the Missouri river.

In reference to the construction of a bridge at St. Louis, which was one of the bridges authorized by this act, the law provided that it should not be either a suspension bridge or a draw-bridge, but that it should have continuous or unbroken spans, with the bottom chord 50 feet above the city directrix at its greatest span; that it should have at least one span of 500 feet in the clear, or two spans of 350 feet in the clear, and that no span over the water at low-water mark should be less than 200 feet in the clear. A later act required that the bridge at St. Louis should have one span of at least 500 feet in the clear.

In reference to bridges over the Ohio the provisions for the Steubenville bridge were that it should leave an unobstructed headway in the channel of the river of not less than 90 feet above low-water mark, and an unobstructed width of not less than 300 feet between the piers next to said channel or waterway; and one of the spans next adjoining that should not be less than 220 feet in length. The law required that if it was built as a high bridge it should be not less than 90 feet above low water over the channel, and if built as a draw-bridge it should be constructed with a span over the main channel 300 feet in length and not less than 70 feet above low-water mark, and one of the adjoining spans not less than 220 feet, and also that there should be constructed a pivot-draw in every such bridge in a navigable part, with spans of not less than 100 feet on each side of the pivot. A law passed in 1871 made it unlawful to proceed with the construction of a bridge then being built between Cincinnati and Covington unless the channel span of 400 feet, as located, should have a clear headway at low water of 100 feet below any part of the span. Various other acts were passed in the early years of the eighth decade which insisted upon requirements more favorable to river interests than those which had been deemed necessary during the seventh decade.

THE BRIDGE WORK COMPLETED

in accordance with the above enactments, either before 1870 or a few years later, included railway bridges over the Ohio at

Steubenville, Bellaire, Parkersburg, Cincinnati, and Louisville, which were important and expensive structures.

The bridge erected over the Ohio at Louisville connected the Jefferson, Madison and Indianapolis Railroad, which, as well as the bridge, forms part of the Pennsylvania system, with the Louisville and Nashville Railroad. Its total length is 5,294 feet, consisting of twenty-seven spans, of various lengths, from 50 to 250 feet, on the Fink plan, placed below the grade of the road, and two channel spans, one 370 and the other 400 feet long, placed above the grade of the road. The bridge was commenced in the fall of 1867, and completed in the spring of 1870. The channel spans are of a peculiar design, a modification of the triangular plan of bracing, by introducing auxiliary trusses between the main braces. The feet of the main braces are 56 feet 7¼ inches apart, and by the auxiliary trusses this space is divided into four parts, giving a support to the stringers, upon which the track rests, every 14 feet 1¾ inches. The height of the truss is 46 feet. Each side of the bridge consists of two separate trusses, which are simply bolted together. The chords are of cast iron, the braces having to resist compression of wrought iron, and the tension members also of wrought iron. The following is a statement of the quantity of iron in some of the principal spans:—

	Cast iron. Pounds.	Wrought iron. Pounds.	Total. Pounds.
400 feet span	570,585	834,880	1,405,465
370 "	480,953	640,095	1,121,048
245½ "	216,119	215,803	431,922
180 "	123,308	91,259	214,667
150 "	101,453	70,224	171.677
100 "	58,725	29,183	87,908
50 "	7,557	15,801	23,358

The Newport and Cincinnati bridge, crossing the Ohio river at Cincinnati, and furnishing connection between north and south railways converging at Cincinnati, as well as a highway or common road connection between the cities named above, belongs to the Pennsylvania system. It also owns or controls the Steubenville bridge. The Ohio was bridged by the Baltimore and Ohio at Bellaire and Pittsburgh, by expensive structures.

Bridges over the Missouri at St. Charles, Boonville, Kansas City, Leavenworth, Atchison, St. Joseph, and Nebraska were finished by or before January, 1874. The St. Charles bridge was commenced in 1868 and finished in 1871, at a cost of $1,797,186.19. It is regarded as an admirable structure, designed by Gen. C. Shaler Smith, and built by Smith & Latrobe, Baltimore Bridge Company. The bridges at Boonville, Kansas City, Atchison, and St. Joseph were all railway draw-bridges. The bridges at Leavenworth and Omaha were elevated railway bridges.

The list of bridges erected over the Mississippi either before or shortly after 1870 includes the following: A railway draw-bridge at St. Paul which was opened for travel in 1869. A railway draw-bridge extending from Hastings, Minnesota, to Prescott, Wisconsin, which was opened for railway travel in 1871. A railway draw-bridge at Winona, Minnesota, in 1869–70. A railway draw-bridge at La Crosse, Wisconsin. A pontoon railway bridge from Prairie du Chien, Wisconsin, to North McGregor, Iowa, which was opened for railway travel in April, 1874. A railway draw-bridge at Dubuque which was opened for travel in December, 1868. A railway draw-bridge at Clinton which was opened for railway travel in January, 1865. The new bridge at Rock Island, which is a combined highway and railway draw-bridge, and was opened for travel in October, 1872. A railway draw-bridge at Burlington, Iowa, opened for travel in 1868. A railway and highway draw-bridge at Keokuk, Iowa, opened for travel in 1870. A railway draw-bridge at Quincy, Illinois, opened for travel November, 1868. A railway and highway bridge near Hannibal, Missouri, which was opened for travel in 1871. A railway bridge at Louisiana, Missouri, which was opened for travel in 1873. An elevated railway and highway bridge at St. Louis which was opened for travel in July, 1874.

It will be seen by the above list that nearly all the bridges enumerated were draw-bridges, but one was a pontoon bridge of novel design, and another the famous elevated bridge at St. Louis.

THE MISSISSIPPI RIVER DRAW-BRIDGES

varied considerably in their superstructure, wood being the principal material in some instances and iron in others, and also in the arrangement of their draws, piers, and spans. Some of the bridges were built by private bridge companies, others by railway companies, and one, the new Rock Island bridge, under the direction of the United States engineers, acting on behalf of the United States government. Some of the bridges were crossed only by the trains of one railway company, and others by the trains of several companies. On account of the magnitude of the labors involved, a number of the bridge-contracting companies of the country, including the American Bridge Company, of Chicago; the Keystone Bridge Company, of Pittsburgh, the Detroit Bridge Company; the Phœnixville Bridge Company; the Baltimore Bridge Company; the Detroit Bridge and Iron Works, and the Kellogg Bridge Company, of Buffalo, furnished portions or all of the superstructure of one or more of the Mississippi river bridges.

The bridge with the longest draw-span, and with what was the longest draw-span in the United States at the time of its construction, was the Louisiana Railway bridge at Louisiana, Missouri. The river at that point is about 3,700 feet wide at low water, and the high-water width is several miles. Commencing on the right bank, the abutment is approached by an embankment, 450 feet of which are in the low water. The first span is 162 feet to the centre of the draw, west pier; then a draw span 444 feet over all, with two clear openings of 200 feet each; then a span 256 feet; then one of 226½ feet, and then six spans of about 161 feet each from centre of piers, making a total length of bridge of 2,053 feet. From the Illinois end of the bridge there is 2,200 feet of embankment. The piers are of masonry. The superstructure is of wrought iron, except in some minor parts.

THE PONTOON BRIDGE

at Prairie Du Chien was designed and constructed by Mr. John Lawler, to meet the particular wants of that locality. It is built at a point where the river is divided by an island and is about 1¼ miles in width from shore to shore. Formerly passenger and freight cars were transferred by ferry boats which had to go around the head or foot of the island, making the distance from landing to landing nearly four miles; and when floating ice accumulated the river was frequently impassable. The construction of a bridge of either of the standard descriptions would have been peculiarly difficult or expensive. These circumstances led to the adoption of a system under which the bridge approaches on either shore, and the fixed portions of the bridge in low water and on the island, consist of piles, while in the channels of the river pontoons are placed, which are so combined and arranged as to form a railway bridge when the passage of trains is desirable; while when the use of the channels by steamboats or rafts is necessary the pontoons are temporarily removed. The pontoon in the east channel is made by uniting three ordinary transfer scows which have an aggregate length of 393 feet, and the pontoon in the west channel is a single-deck scow especially constructed for the purpose, 408 feet long, 28 feet beam, and 6 feet in depth. Applications for the right to construct bridges of a similar plan at various other points on the Mississippi and elsewhere have been made and granted.

THE ELEVATED RAILWAY AND HIGHWAY BRIDGE AT ST. LOUIS

was, at the time of its completion, the most expensive bridge that had then been constructed in the United States. Its cost, including approaches, tunnel and land damages, legal expenses, discounts, commissions on bonds, &c., was $12,680,333.47. The width of the river at the point of construction is about 1,200 feet at low water and 1,900 feet at high water. Considerable difficulty was experienced in procuring a foundation for the piers and abutments on the bed rock of the river, but by means of inverted caissons and the plenum pneumatic process they were all surmounted. The abutments are placed on the margin of the water at ordinary low stage, with two piers in the channel way. The three spaces thus left are spanned by circular segment arches. The middle one has a chord of 515 feet, and the crown of the arch is 55 feet above the city directrix, which is 33½ feet above low water. The superstructure was erected by the Keystone Bridge Company, and an indication of the amount of work performed is furnished by the fact that its cost, excluding approaches, was $2,234,655.42. The masonry, including abutments, piers, tools, and machinery, was $2,364,452.26.

This was one of the first of American bridges in which steel was extensively used. The supporting members of the superstructure consisted of 24 steel arches, 8 in each span. Each arch is composed of a large number of straight tubes, with slightly beveled ends, and to the casual observer appears to be a continuous curved tube. The whole number of tubes is 1,036. A tube is about 12 feet long, and comprises a steel envelope ¼ inch thick, and 6 rolled steel staves, varying in thickness from 2½ inches at the springing to $1\frac{3}{16}$ inches at the crown. The exterior diameter is always 18 inches. Steel or wrought-iron sleeve couplings firmly unite the tubes by means of parallel grooves turned on the ends of the staves. About 2,200 tons of steel and 3,400 tons of iron are used in the whole bridge. The upper roadway of the bridge is 54 feet wide. The public test of the bridge consisted of placing fourteen locomotives simultaneously upon the tracks of a single span. The construction of the bridge was commenced during the seventh decade, and it was publicly opened on July 4th, 1874.

IMPROVEMENTS OF LOCOMOTIVES.

INCREASE OF SIZE AND CAPACITY.

THE London Engineer said, in 1864, that it was the general belief thirteen years previous that nothing exceeding thirty tons was admissable in a locomotive, and nothing over twenty tons desirable, at least upon the standard gauge. It proceeded then to give descriptions of engines then in use in various countries, some of which weighed from 40 to 50 tons when loaded. A long wheel base, and steel rails were referred to as leading causes of the marked increase in the admissable weight of a locomotive.

In 1864 it was reported that engines weighing 37½ tons were running over the Atlantic and Great Western Railway of the United States.

Among other notable locomotive improvements in this country it was announced in November, 1863, that James Millholland, engineer of machinery of the Philadelphia and Reading Railroad, had designed a pusher of extraordinary weight and power to assist in transporting heavy coal trains to the city of Philadelphia over ascending grades. Its weight was 100,320 pounds, and there was probably, at that time, no other locomotive of equal size in the United States.

Special efforts were then being made to increase the locomotive capacity of the Philadelphia and Reading, on account of the extraordinary demand for coal and difficulty of supplying it. In 1863 its loaded coal trains averaged loads of 514 tons, of 2,240 pounds each, and new engines had been introduced which drew 150 cars containing about 4½ to 5 tons each, or nearly 750 tons of coal.

CONSOLIDATION AND MOGUL ENGINES.

In 1866 the engine "Consolidation" was built at the Baldwin Locomotive Works for the Lehigh Valley Railroad, intended for working on a plane which rises at the rate of 133 feet per mile. It had cylinders 20×24, four pairs of wheels connected, 48 inches in diameter. A class of engines known as Moguls, with three pairs of wheels connected, and a swinging pony truck in front, equalized with driving-wheels, was also built at the Baldwin Locomotive Works for the Thomas Iron Company in 1867. Since that period a large number of consolidation and mogul engines have been built by various makers of this country, which possess exceptional power in drawing large loads of freight over heavy grades. They have done much to cheapen freight transportation in a number of sections. Even the earliest locomotives of these patterns, and to a greater extent those of the present day, greatly exceed the locomotive capacity that was originally deemed attainable. An interesting article published about 1881 on locomotive development, in discussing the consolidation engines, said:—

"Upon standard-gauge roads the freight engine of the immediate future is likely to be the consolidation or eight-coupled ten-wheeler, the 'E' engine of the works. At least this is the engine which will give the most economical result on all roads when the capacity is in any way taxed. Of course, it is possible that this centipede type, of which we have just spoken, may some time become necessary even on level lines of standard gauge. The regular consolidation pattern is made up to a weight of 108,000 pounds in working order, of which some 94,000 are upon the drivers. The cylinders for the heaviest engines are 20 inches in diameter, and 26-inch stroke, with 48 or 50-inch drivers. *Such an engine is capable of hauling a total load of 2,740 gross tons on a level track.* In regular work they will take trains of 90 loaded cars (box). In one case, on the Philadelphia and Erie road, a consolidation engine hauled 180 cars and a 'dead engine.' Though not intended for speed, they easily make 25 miles per hour. Though aggregating an enormous weight, they do not exceed in the weight per wheel, the load the larger sizes of express passenger engines of the American pattern put upon the rails. It is a well-proven fact that it is much better to add an extra pair of drivers to increase the adhesion than to attempt to greatly increase the load upon a smaller number. By the use of flanges on the main and railing drivers only, leaving the others plain, the rigid wheel base is reduced to 9 feet 2 inches, with 50-inch wheels, which is only 6 inches more than that of the heavier American passenger engines with 60-inch drivers. Whether the needs of traffic in the future will require further addition to the tractive force remains to be seen. Possibly, as cars become heavier and stronger, and longer trains can be handled, still heavier weights in freight engines will be desirable."

LOCOMOTIVE STEEL TIRES.

Of Krupp's patent steel tires it was reported in June, 1864, that a set of them had been running under an engine on the Chicago, Burlington and Quincy for thirteen months. This engine weighed 34 tons and was used in the heaviest freighting service of the road. It was reported that in backing out of a snow bank its wheels were found to slip less and to bite stronger than those tired with iron. Also that after thirteen months service the wear had been very slight, and the tire was considered good for another year before it received its first turning.

In reference to a change from iron to steel tires which was progressing during the seventh decade the London Railway News, of April 5th, 1865, said that "the Maryport and Carlisle company had found that with the ordinary iron tires on the engine wheels, the distance run was not more than 90,000 miles—in many cases not more than 60,000 miles—and the wheels must be taken from the engine for every 20,000 or 30,000 miles run, for repairs and 'turning up.' In the case of steel tires, the wheels will run 100,000 miles before they require 'turning up' or repairing. The result of a very careful examination of the effects of wear leads to the opinion that these wheels will run from 350,000 to 500,000 miles, or equal to some twelve or fifteen years' work of a daily average of about 100 miles."

LOCOMOTIVE STEEL TIRES.

One of the mechanical advances of enduring importance was the commencement of the use of steel tires on locomotives. The date of this change is indicated by the statement that steel tires were first used in the Baldwin Locomotive Works in 1862, on the engines for a railway in Brazil, and that their general adoption on American railroads followed somewhat slowly. No steel tires were then made in this country, and M. W. Baldwin & Co. imported five hundred from which to fill orders.

Some of the early tires were imported from England, but importation of Krupp tires were also made at an early date. In 1864 it was reported that the following companies were using the Krupp steel tire for locomotives:—

Galena and Chicago Union; Chicago and Milwaukee; Chicago and North-western; Michigan Southern; Michigan Central; Louisville and Nashville; Bay de Noquet and Marquette; Central Georgia; Delaware, Lackawanna and Western; Erie; Hudson River; Camden and Amboy; Housatonic; Naugatuck; Northern, of New Jersey; New Haven; New Haven and Hartford; Beaver Meadow; Chicago, Burlington and Quincy; Great Western, of Illinois; Great Western, of Canada; Grand Trunk, of Canada; Ohio and Mississippi; European and North American, and Lehigh Valley.

The actual wear of steel tires has in many cases proved entirely satisfactory, and after their advantages had been tested, and arrangements for manufacturing them in this country had been made, so that a competition was created between home and foreign makers for the American market, their use became practically universal, and it was one of the important agencies in promoting the rapid increase in the size and capacity of locomotives which has since occurred. A practice adopted about 1870 of shrinking the steel tires on wheels in a manner which dispensed with all artificial fastening has added to their utility. At the same time, great variations have occurred in the amount of service obtained from tires. The National Car and Locomotive Builder, in an article on this subject, says: "The circumstances connected with the wear of tires are often of a nature to puzzle the observer. A master mechanic, who devoted careful attention to the tire question, mentioned a curious performance of a set of tires. The engine was on heavy passenger service, and was run continually by one engineer. The tires were put on in the beginning of winter, and ran close on two years before they needed turning, having made about 18,000 miles to each $\frac{1}{16}$ inch of wear. At the end of another year the tires had to be turned, with about 8,000 miles to the $\frac{1}{16}$ inch of wear. After that the engine made about 20,000 miles to the $\frac{1}{16}$ inch of wear for the remainder of the life of the tires. There was no extra work done during the period the tires wore fast, and the same man held the throttle. Of course, this is a striking instance of the 'uncertain in locomotive engineering,' but there was a cause for the rapid wear, if it could only have been discovered, and it would be a good work in the cause of knowledge if those who come in contact with 'mysterious' cases of this kind would display energy and ingenuity in finding out their origin.

Complaints that we have heard made about the tires of certain locomotives wearing badly in comparison to others are susceptible of easy explanation. Tires wear in two ways. The weight of the engine pressing upon the drivers leads to abrasion of the surface coming in contact with the rail, and as the wheels roll round the tire wears away by the minute bruised particle dropping off. That is the wear of rolling friction. The second method of wear is that of sliding friction, where the slipping of wheels on the rails grinds away the tires, as an emery wheel wears away the surface from any article put in contact with the revolving face. The sliding friction, where it comes much into action, is by far the most disastrous to the life of locomotive tires. Inordinate slipping of driving wheels results from two leading causes—very hard tires and too little weight on the drivers. The art of making steel tires is so highly perfected that tires too hard for economical service are rarely produced. When an engine is noted for slipping badly the cause is nearly always that the cylinders transmit too much power for the adhesive weight upon the drivers."

STEEL FIRE-BOXES, FLUES, AND BOILERS.

In addition to the demand for steel rails and steel locomotive tires other evidences of the growing disposition to substitute steel for various railway purposes to which iron had previously been applied, were furnished during the seventh decade. At the Baldwin Locomotive Works steel fire-boxes were first built for some engines for the Pennsylvania Railroad Company in 1861. English steel of a high temper was tried, but it did not prove successful. American homogeneous cast steel was then tried on two engines in January, 1862, and found to answer the requirements so well that Baldwin's Illustrated Catalogue, of 1881, says: "The fire-boxes of nearly all engines thereafter built for that road were of this material, and in 1866 its use for the purpose became general. It may be added that while all steel sheets for fire-boxes or boilers are required to be thoroughly annealed before delivery, those which are flanged or worked in the process of boiler construction are a second time annealed before riveting." The same work says: "Steel flues were first used in three 10-wheeled freight engines, numbers 211, 338, and 368, completed for the Pennsylvania Railroad in August, 1868. Flues of the same material have also been used in a number of engines for South American railroads. Experience with tubes of this metal, however, has not yet been sufficiently extended to show whether they give any advantages commensurate with their increased cost over iron. Steel boilers were first made in 1868 for locomotives for the Pennsylvania Railroad Company, and the use of this material for the barrels of boilers as well as for the fire-boxes has continued to some extent. Steel plates somewhat thinner than if of iron have been generally used, but at the same time giving an equal or greater tensile strength. The thoroughly homogeneous character of the steel boiler plate made in this country recommends it strongly for the purpose." A sketch of the Pennsylvania Railroad, issued by that company in 1875, in referring to its locomotives, says: "The boilers are made of soft crucible cast steel, great pains being taken to secure the best attainable quality. From every sheet of steel a test piece is taken, which is heated to redness and is then dipped in cold water, after which (while cold) it is bent double and hammered flat. Any sheet that will not bear this test is rejected. The tires, crank-pins, and guides of all the engines are of steel; and on the passenger engines the connecting rods, tender, and truck axles are of steel also."

IMPROVEMENTS OF CARS.

PROGRESS in connection with the improvement of the details of car construction has been one of the notable features of railway development at all periods since the operation of important lines commenced. In the seventh decade advances made in connection with passenger cars attracted much more public attention than those made in freight cars, as that was the era in which the use of sleeping cars first became general on through routes, and parlor and dining cars were placed on a few lines. But the methods of manufacturing things common to all classes of cars, such as springs, wheels, and axles, were, like everything else connected with railways, undergoing important improvements, which necessarily exerted a beneficial influence on some of the details of freight-car construction, and various new devices peculiar to freight cars were introduced. Special advances of the period were the introduction of steel axles on the passenger cars of some lines, and a great improvement in springs, especially elliptic springs.

One of the events of the decade, which has since exercised an important influence on all matters connected with car construction and car repairs, was the organization, in 1867, of the Master Car-Builders' Association, a body which embraces in its membership many of the master car builders of the country, who meet at least once a year, and by much more frequent interchanges of views on various subjects promote the formation and dissemination of correct views in reference to important labors in which they are engaged. In the same year an organization of the railway master mechanics was effected, which has since served analogous purposes in reference to the construction and repair of locomotives.

One of the greatest improvements made during or towards the close of the decade was probably in the

INCREASE OF THE NUMBER OF CARS.

The war had deranged all ordinary calculations by creating an extraordinary demand for both freight and passenger movements between numerous points, and as much uncertainty prevailed in regard to the probable continuance of some of these requirements, conservative railway managers were loth to purchase at high war prices equipment for which it might soon be difficult to find employment. This indisposition to incur outlays that might become unprofitable was one of the reasons for starting some of the fast freight lines of the country, which assumed the risks involved.

Making all due allowance for the great increase which has occurred in the business of leading lines since 1865, it has been exceeded by the relative increase of cars or car capacity since that time, and a fair start in this direction was made before 1870. Low's Railway Directory of 1865 gives the following particulars in regard to the number of cars and locomotives of the representative lines named below:—

	Length of road, miles.	Passenger cars, 1st class.	Passenger cars, 2d class.	Baggage cars.	Freight cars.	No. of locomotives.
Boston and Lowell	115	36	..	19	916	34
Vermont Central	160	34	..	8	951	48
Western (of Massachusetts)	156	51	..	12	1,099	73
Hudson River	150	122	11	31	671	67
New York Central	654.5	197	58	68	4,006	239
Erie	806	109	38	55	3,897	243
Delaware, Lackawanna and Western	251.2	15	..	6	*5,369	79
Pennsylvania, exclusive of branches	356	†173	..	49	4,926	290
Phila. and Reading, including branches	147	67	..	..	‡8,430	166
Philadelphia, Wilmington and Baltimore	98	66	4	19	828	40
Baltimore and Ohio	..	..	..	..	....	221
Northern Central	286	45	..	19	3,100	85
Little Miami and Columbus and Xenia	196	34	..	17	638	40
Cleveland and Pittsburgh	124	27	1	20	1,158	56
Pittsburgh, Fort Wayne and Chicago	468.3	67	8	24	1,703	146
Chic., Bur. and Quincy, with branches	364	32	4	10	1,220	62
Ohio and Mississippi	340	45	4	9	843	76
Chicago and North-western	891	19	4	8	685	36
Chicago and Rock Island	230	34	..	..	....	61
Chicago and Milwaukee	285	18	6	6	157	11
Illinois Central	708	68	..	29	3,275	133
St. Louis, Alton and Terre Haute	207	23	5	7	946	44
Milwaukee and Prairie du Chien	235	26	4	11	561	44
Michigan Central	284	75	4	18	1,289	97
Michigan Southern & Northern Indiana, with branches	521.5	60	28	28	1,120	88
Toledo and Wabash	243	28	..	20	850	50
Hannibal and St. Joseph	206	22	4	5	400	34
Grand Trunk (of Canada)	857	88	45	60	3,039	227
Great Western (of Canada)	346.5	83	44	20	1,375	94

* Including 500 coal cars. † Of 1st and 2d class. ‡ Including 7,551 coal cars.

It was officially reported by the state engineer of New York in reference to the equipment of all the railroads of that state in 1886 that there was 1 locomotive to the equivalent of 4.37 miles of single track; 1 first-class passenger car to the equivalent of 5.18 miles of single track; 3.57 freight cars per equivalent of mile of single track.

THE AVERAGE WEIGHT AND CAPACITY OF CARS

generally used on the principal lines of the United States of 4-feet-8½-inch gauge, at a period shortly before the close of the seventh decade, was as follows:—

	Weight in pounds.	No. of wheels.	Capacity.
First-class passenger cars	36,000	8	56 passengers.
Sleeper	38,000	12	48 "
Emigrant passenger	21,000	8	60 "
Baggage	28,000	8	..
Box freight	18,000	8	10 tons.
Grain	12,000	4	7 "
Cattle	18,000	8	10 "
Coal cars	13,440	8	22,400 pounds.
"	6,720	4	13,440 "

Attempts to introduce into general service box cars intended to carry a greater weight than ten tons were reserved for a later period. There had, however, been combined post-office and baggage cars introduced, some of which had a capacity of 12 tons, and others of 15 tons. Timber cars with 16 wheels had been constructed, which had a capacity of 40 tons.

It was considered a notable transportation feat in July, 1864, that mammoth trucks, specially constructed for the purpose at the Altoona shops, had proved strong enough to bear the strain of a cannon manufactured at Pittsburgh, and weighing 116,497 pounds, while it was being moved over the line of the Pennsylvania Railroad from Pittsburgh to Philadelphia.

In addition to the passenger and sleeping cars mentioned above, there was an improved or enlarged passenger car used on some lines which furnished seats for 60 persons, and its weight, empty, was 39,000 pounds. There was also a sleeping coach for 64 passengers, which was abundantly supplied with springs, and its dead weight, without passengers, was 26 tons. Mention is also made of western palace cars on 16 wheels.

SLEEPING-CAR REMINISCENCES.

Of very early sleepers, a newspaper correspondent says: "Within a year I have seen the oldest and the newest sleeping coaches, the remote past and the near future of railroad travel at night. What a contrast the two present! I ran across an early sleeper somewhere in the Blue Ridge mountains in southwest Virginia. It was low and narrow, and dark and stuffy. It wobbled and creaked, and moved in all directions like a ship's compass. It had little windows that you could look out of only by bending double, and a narrow passage walled in by iron rods, one reaching to the roof from the back of every seat. On these poles the upper berths were hitched till they were ready for bedtime. The lower berths were narrow, and so short that you had to lie in one like a half-opened pocket knife, with your knees in the air and the bed-clothes pushed up like a tent. You did not need to be pious in order to thank heaven when you got out of that car."

In 1863 public announcements were made of lines of sleepers of the Central Transportation Company, which had commenced running on the Pennsylvania, Bellefontaine Line, Northern Central, Central of New Jersey, and other roads. An advertisement in which railway companies were invited to use their cars, and builders asked to bid for the construction of 20 additional cars, was published in September, 1863, the principal portion of which is as follows:—

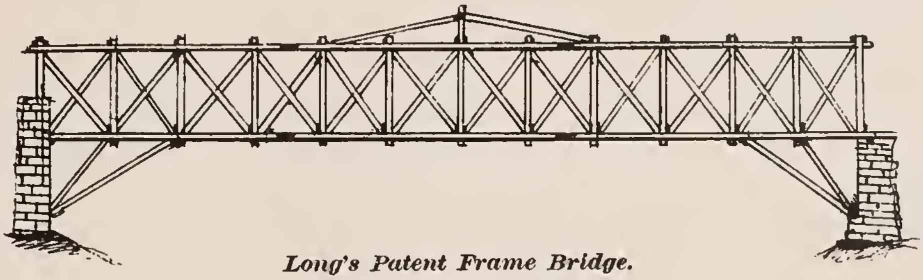
Central Transportation Company.

"This company, a corporation organized in pursuance of the provisions of a general act of the legislature of the state of Pennsylvania, having, by purchase, recently become the sole owner of Woodruff's, Knight's, Myers', and other patents for seats and couches in sleeping cars, would respectfully give notice to all railroad companies in the United States that may desire sleeping cars on their roads that this company is now prepared to negotiate for placing, wholly at its own expense, on such railroads as may require them, their sleeping cars, and operate them upon terms at once liberal and satisfactory to railroad companies.

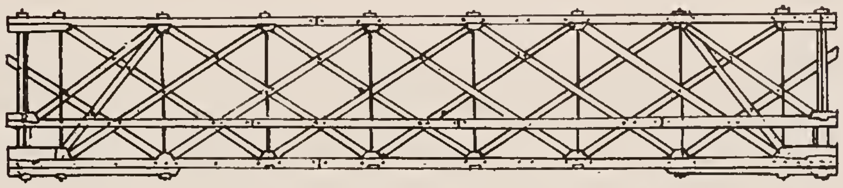
The cars of this company are constructed of great strength, and contain their late improved and patented plans of seats and couches, with state rooms and berths, furnished in a style the most elaborate and tasteful, and are furnished with all the modern conveniences and means of comfort usually found in the sleeping apartments of our first-class hotels. The interior is lighted with gas; they are well ventilated, and at seasons of the year requiring it are warmed with pure heated air, regulated in degree at pleasure by registers in each state-room and section.

Where known these cars are not only regarded as indispensable on all through night trains, but have become desirable above all others, as day cars. Communications from the officers of railway companies, desiring sleeping cars on their roads, addressed to the Central Transportation Company at their office, No. 1347 Brown street, Philadelphia, will receive immediate attention. . . .

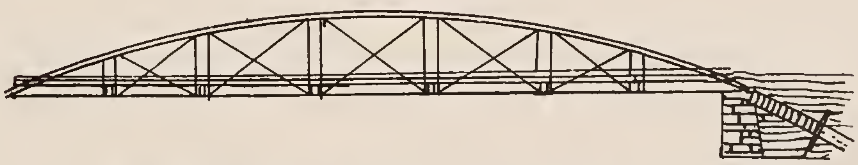
Railway companies using, or permitting to be used on their respective lines, sleeping cars or coaches, that infringe upon



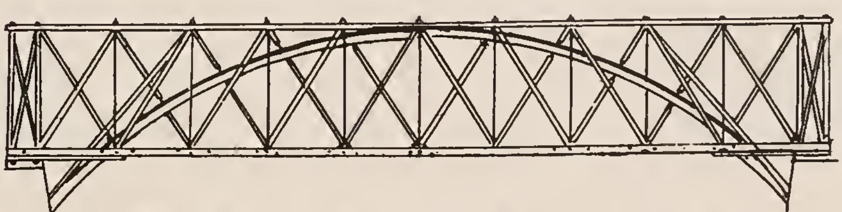
Long's Patent Frame Bridge.



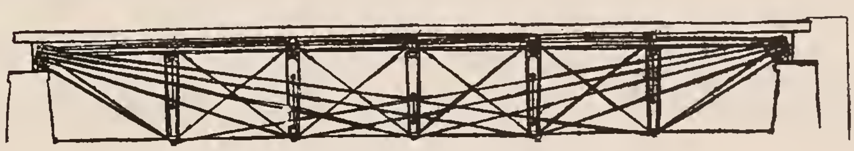
William Howe's Bridge, Patented 1840.



Squire Whipple's Iron Truss Bridge, Patented 1841.



William Howe's Improved Truss Bridge, Patented 1846.



August Bollman's Bridge, Patented 1852.

EARLY AMERICAN TRUSS BRIDGES.

the patents owned by this company, are respectfully notified that satisfactory arrangements for such infringement will be expected. Address as above.

O. W. CHILDS, President."

THE PULLMAN SLEEPING CARS.

Of the operations of George W. Pullman, a sketch recently published in the Chicago Inter Ocean, says:—

"In traveling over the Lake Shore Railroad in 1858, Mr. Pullman saw one of the sleeping cars then just introduced, and he was impressed with the feasibility of developing this germ of comfort into a luxurious vehicle for combined day and night travel. As Fulton, and Watt, and Stevenson, in the crude steam engine of their time, saw the locomotive and marine engine of to-day, so, in the bungling sleeper of twenty-seven years ago, Mr. Pullman saw the modern palace car, that miracle of luxury which now bears his name to the uttermost bounds of civilization.

During the year 1859 he fitted two ordinary passenger cars on the Chicago and Alton Railroad into sleepers, which were a decided improvement over other sleepers of that date, and so created and established the demand for improved traveling accommodations. Meantime Mr. Pullman had engaged in merchandising and mining in Colorado. But in 1863 he disposed of his interests there and returned to Chicago, determined to devote his energies and the means he had acquired in perfecting sleeping and parlor cars, and inaugurating a system for operating them on through lines of railway. He began building the first Pullman car in 1864, now known as the Pioneer, in an old repair shed in the yard of the Chicago and Alton Railroad Company. This car cost about $18,000, occupied more than a year in construction, and was generally regarded as a wonderful triumph in car architecture and decoration; but was the subject of considerable criticism on account of its great weight and size, and also because it involved what was regarded as an extravagant outlay of money. But the traveling public were quick to see its many advantages, and its adoption by the leading western roads soon followed.

The Pullman Palace Car Company was organized in 1867, with Mr. Pullman as president, and it now operates more than 1,300 cars over more than 70,000 miles of railway in America and Europe, and has completely revolutionized the methods of modern travel. In its manufacturing and repair departments, including the operating department, it employs over 8,000 men."

CONTEMPORANEOUS VIEWS OF EARLY PULLMAN CARS.

In August, 1865, it was stated that "a new sleeping car had been patented by George M. Pullman, of Chicago. It is set upon sixteen wheels, with two sets of trucks at each end, with the springs so arranged that but little of the unevenness of the track is felt. It is ventilated by registers in the ceiling, and warmed from beneath by registers in the sides. By folding doors a smoking department can be provided at each end. There is also a space at each end furnished with sofas, chairs, &c., which can be enjoyed by persons traveling in a party. It is so arranged that screens between the berths can be so closed that it will have the appearance of a splendid day car. Several of these cars are soon to be placed on the Michigan Central."

Charles G. Leland, a distinguished author and journalist, formerly of Philadelphia, in an account of a western trip made in 1866, said: "A remarkable subject of interest, which our party examined this morning, was the City of Chicago—not the metropolis itself, but its reflection, as regards splendor and enterprise, in a sleeping car of that name, which runs on the Illinois Central. This car cost $20,000, and is said to be cheap at the price. Every comfort which can be placed in such a vehicle is to be found within its wooden walls. The seats, the sides of the car, and the ceiling are exquisitely adorned in *marquetrie* or inlaid woods, while the gilded glass frames, in *ormolu*, and the general tone of color, are truly artistic. It is heated by a separate furnace beneath, and its lounges and mirrors, with every other luxury, make it in fact a rolling palace. Not less remarkable is the corresponding seat car for day passengers, which surpasses in splendor, and still more in comfort, any car which I have ever seen on an eastern road. There is yet another car, which cost *thirty thousand dollars*, which I did not see, but which was described as a miracle of its kind."

THE WESTINGHOUSE AIR BRAKE.

Of all the improvements made during the seventh decade, applicable to car or train movements, none have had a wider field of usefulness than the Westinghouse air brake. A sketch recently written says that the first train ever equipped with it "was the Steubenville accommodation train, running on the Pittsburgh, Cincinnati and St. Louis road. It consisted of three cars and an engine, and its first run with the air-brake equipment was made in the winter of 1868–9. The first step demonstrated the value of the invention, and satisfied all who witnessed it that the days of braking passenger trains with hand brakes were numbered.

In a short time the attention of the officials of the Pennsylvania Railroad was attracted to the invention, and it was first put on the Wall's accommodation trains on that road, and subsequently on all the passenger trains.

In August, 1869, less than a year after the first trial of the brake on the regular passenger train, an engine and six coaches belonging to the Pennsylvania Railroad Company were run to Chicago for the purpose of exhibiting the air brake at that important railway centre. Trial runs and stops were made by this train on the Chicago and North-western Railway in the presence of a large number of railway officers in that city. The quick stops made, so much shorter than anything that could possibly be done with hand brakes, and the perfect control of the train which the air brakes gave to the engineer, awakened a high degree of interest and even enthusiasm on the part of those who witnessed the experiments.

In the same year (1869) an exhibition of the power of the brake was made on the mountain grades of the Pennsylvania Railroad. This was attended by a number of officials of eastern railways, and the remarkable stops shown on steep grades added greatly to the reputation of the brake. As a result of these public trials, several railway companies sent in orders for brakes to equip trial trains. This, in all cases, resulted in the adoption of the brake for all its passenger equipment by each road which fitted up an experimental train. The movement soon became general, and by the year 1875 the passenger trains of nearly all the principal roads of the country were fully equipped with the Westinghouse air brake."

MISCELLANEOUS MECHANICAL PECULIARITIES AND ADVANCES.

INCREASE OF THE COST OF RAILWAY CONSTRUCTION, SUPPLIES, AND OPERATING EXPENSES.

A NOTABLE feature of the seventh decade, especially during the first half, while the civil war was raging, was the disturbing influences engendered by the war, the suspension of specie payments, the premium on gold, and the extensive issues of greenbacks, on the price of all the outlays of new and old railway companies for labor and materials, and the rapid increase in the cost of construction and operation. The advances were by no means uniform, the price of some things being greatly enhanced, while the current value of others was only affected to a comparatively limited extent. The

EFFECT OF THE NEW ORDER OF THINGS ON CONSTRUCTION

is, to a limited extent, indicated by the following statements, but there were periods when the advances represented a much larger percentage than that shown by the estimates given below, as those for 1865 were made about the time the war was ended, and after a marked decline in wages and various kinds of materials had occurred.

A detailed estimate of the cost of the construction of a railroad between Hagerstown and Cumberland, made by W. W. Taylor, civil engineer, and published in May, 1865, stated that the total probable outlay then would be $4,185,096, while the estimated cost of the same work previous to the war, in 1860, was $2,802,693. The items are as follows:—

	Estimates for 1865.	Estimates for 1860.
2,750,836 cubic yards embankment	$962 792 (at 35 cts.)	$687,709 (at 25 cts.)
965,000 cubic yards excavated	$1,251,000 (at $1.40)	$863,500 (at 90 cts.)
*49,400 cubic yards tunnel excavated	$172,900 (at $3 50)	$123,500 (at $2 50)
8,483 cubic yards culvert masonry	$25,449 (at $3)	$21,207 (at $2.50)
Walling and arching tunnel	$57,000	$40,000
5,893 cubic yards arch culvert masonry	$29,965 (at $5)	$20,975 (at $3 50)
23,490 cubic yards bridge masonry	$164,430 (at $7)	$117,450 (at $5)
3,640 lineal feet bridge superstructure	$91,000 (at $25)	$72,800 (at $20)
8,100 tons iron, 60 lbs. per yard, 86 miles track	$810,000 (at $100)	$405,000 (at $50)
172,000 cross ties	$43,000 (at 25 cts.)	$34,400 (at 20 cts.)
151,360 cubic yards ballast	$151,360 (at $1)	$105,952 (at 70 cts.)
86 miles track laying	$43,000 (at $500)	$25,800 (at $300)
86 miles chairs and spikes	$60,200 (at $700)	$34,400 (at $400)
Land damages	$25,000	$20,000
Grubbing and clearing	15,000	10,000
Water stations	8,000	5,000
Engineering three years	75,000	60,000
Stations, engine houses, and machine shops	200,000	150,000
	$4,185,096	$2,802,693

* The entire estimates for the tunnels are for double track.

The Pennsylvania Railroad report for 1864, dated February 18th, 1865, in referring to construction of new lines, said: "From an analysis of these expenditures it appears that it *now* requires about three dollars to perform the office of one dollar in 1861." This change probably more faithfully reflects the actual transition than any other condensed statement.

The average price of iron rails in eastern Pennsylvania, per ton of 2,240 pounds, in January of each of the years named below, was as follows: 1860, $48¾; 1861, $44; 1862, $36½; 1863, $72½; 1864, $94; 1865, $125⅝; 1866, $90; 1867, $85; 1868, $81⅔; 1869, $76¾. The average price of Bessemer steel rails at works in Pennsylvania, per ton of 2,240 pounds, in the month of January, was $165 in 1868, $145 in 1869, and $110 in 1870.

INCREASED COST OF EQUIPMENT AND OPERATING EXPENSES.

The report of the superintendent of the Pennsylvania Railroad for 1863 announced an increase in regular working expenses of $922,903.67, without any notable increase in aggregate of business.

The report of the North Pennsylvania for the year 1864, dated January 5th, 1865, said "passenger cars now cost twice as much as they formerly did."

The report also makes reference to the construction of a number of stations and depots, &c.

Of operations of Philadelphia and Reading for the year ending November 30th, 1864, the report for that period said:—

The receipts and expenses for each class of traffic per passenger and per ton have been as follows:—

	1863. Cost.	1863. Receipts.
Per passenger	$0.91 3/10	$2.67 3/10
Merchandise per ton	.50 3/10	1.03 2/10
Coal per ton	.47	1.59 8/10

	1864. Cost.	1864. Receipts.
Per passenger	$1.13 7/10	$2 65 8/10
Merchandise per ton	.63	1.18 2/10
Coal per ton	.81	2.35

The report of J. Dutton Steele, chief engineer of the Philadelphia and Reading, for 1864, says: "The continued advance in values of all kinds, as measured by the present standard of currency, is more clearly shown in the present than in any previous annual exhibit. . . . The roadway expenses for the year have reached $722,176.28, against $374,386.99 in last year, and the cost per ton per mile has been 19/100 of a cent, whilst in 1863 it was 13/100 of a cent per ton per mile. If we compare these figures with those of 1860, we shall find them very nearly doubled, the cost of sustaining the road in that year being ⅛ of a cent per ton per mile only, a result which may be deduced directly from the inflation in prices, when not relieved by any of the mitigating circumstances which have heretofore existed to a greater or less extent."

In the report of the Erie Railroad for 1864 a list of liabilities was published, which embraces the following statements of the amounts the company had agreed to pay for new equipment:—

29 freight cars to receive	$31,436 00
13 engines to receive in March, 1865	339,356 15
16 engines to receive in April	451,464 48
22 engines to receive in May and June	842,000 00

The report of Huntingdon and Broad Top Mountain Railroad and Coal Company for 1864 says: "One new engine was purchased in October at a cost of $23,690, and one 10-wheeled engine, contracted for in June, has been delivered since the first of the present year, at a cost of $28,840. Three new 8-wheeled trucks, or gondola cars, worth $3,000, were built at the company repair shops during the summer."

It was reported in New England in 1864 that such a locomotive as could have been purchased for $8,000 before the war then cost $25,000.

RAILWAY SHOPS ESTABLISHED BY UNITED STATES GOVERNMENT FOR MILITARY RAILROADS.

In connection with the mechanical developments and arrangements of the seventh decade, interesting indications of some of their characteristics are furnished by a description of the military railroad system of the United States, published in the latter part of 1864, written by Mr. Benjamin C. Truman, a correspondent of the New York Times. After referring to the occupancy of Nashville by Union troops in 1862, and subsequent control of surrounding regions by Union armies, with the accompanying necessity for operating the railways by which they were traversed, the writer stated that there had been organized, under the direction of General McCallum, Mr. A. Anderson, Colonel J. C. Crane, quartermaster of the department, and the commander-in-chief of the military division of the Mississippi, about fifteen hundred miles of road, composed principally of the Nashville and Chattanooga, and Tennessee and Alabama railroads, on which eighteen thousand men were employed as mechanics, engineers, blacksmiths, conductors, brakemen, laborers, &c., at a monthly expense of $2,200,000. He said that "to Colonel Crane must the highest honors belong for the existence of this stupendous transformation. His is the executive eye." The rolling stock consisted of 271 engines and 3,000 cars. New shops had been erected, of which the following descriptions were given: "The locomotive and machine department is under the efficient superintendence of Mr. E. P. Benjamin, and employs 3,000 men. The main building is 240×80 feet, and is in process of extension, its projected extreme length to be 450 feet. The upper part of this building is used for rebuilding and repairing locomotives and tenders, and is called the erecting floor. The capacious room will accommodate 34 engines at a time. Really, the shop has not yet built a new locomotive, but every piece of machinery necessary in the construction of an engine or locomotive, with the exception of a wheel tire, has been turned out. Captured and crippled locomotives find their way to this shop, and in a few weeks steam out as good as new. The foreman of the locomotive shop pointed out to me a magnificent-looking engine, which had been *elevated from a worn-out boiler.* Everything about the structure had been manufactured in this shop except the boiler and driving wheels. While I think of it here, nothing is manufactured by the Government, the foreman informed me, which involves a loss, except a steam whistle. These can be bought cheaper than they can be manufactured, and the manufacture has been discontinued in consequence.

Machine Shop.—Adjoining the huge building is the machine shop, which is over 200 feet long, filled with the most improved machinery of the age, up stairs and down. There are some very fine machines down stairs, including a lathe for turning heavy shafting; a lathe for truck axles; compound planer, for all kinds of light planing; two heavy planers; drill press, for doing all sorts of light and heavy drilling; heavy drill press; large lathe, for turning locomotive driving wheels; slotting machine, used for horizontal planing; and two boring drills. In the upper machine shop are five bolt-cutting machines, capable of doing the heaviest of work; cotter and key-seating machine, self-feeding; several gear-cutting machines; six drilling machines; large boring and turning drill; large hydrostatic press, for putting car wheels on axles; two large driving-wheel lathes; seven planing machines; two milling machines; and twenty lathes, of all sizes and descriptions. The entire machinery is new, and of the most approved pattern, and is chiefly from the well-known establishments of William Sellers, Philadelphia; Bement & Dougherty, Industrial Works, Philadelphia; Putnam Machine Company, Fitchburg, Massachusetts; Lowell Machine Company, Lowell, Massachusetts; John Paisley, New Haven, Connecticut, and others. The machinery of the whole establishment is run by two horizontal engines of 300 horse-power. These engines were formerly in the Memphis navy yard.

Blacksmith Shop.—One of the most perfect and completely-arranged blacksmith shops is connected with the locomotive and machine department. The foreman of the shop, Mr. Duncan Livingstone, pronounces it the completest workshop of the kind in the country. It is about 200 feet in length, and 80 in width, and employs nearly 200 of the best blacksmiths that could be found, all of whom receive from $3.50 to $10 a day. There are 40 forges, which are blown by steam. By an invention of one of the employés of this shop the ashes and coal dust are carried off by the same blast which blows the fire, making the forge present a clean appearance at all times. Every variety of heavy work as well as light is turned out here. Connected with this department is a foundry, in which all kinds of work are turned out. There are also carpenter and pattern shops, in which the wood work for the locomotive and tenders is manufactured. A 'round-house,' which is to be the largest in the country, is in process of erection, which, when completed, will have sixty stalls, and will be so constructed that 100 locomotives may be accommodated at a time.

The Car Department.—The main building of the car department is 202 feet long and 80 wide, and is solely used for the manufacturing and repairing of cars. At present, Mr. Herrick is having a headquarters car built for General Thomas, which, for convenience and elegance, is the finest affair I have ever seen. With the exception of the ornamental work, this model combination of house and carriage is complete. It is an iron-plated vehicle, 50 feet in length and of the usual width, containing a kitchen, dining saloon, sleeping apartment, wash room, water closet, and office. Nothing could be more complete, while the upholstery and ornamental work is *recherche.*

The cars are all ventilated by an invention of the manufacturer, and when empty present a mass of net work, composed of iron and India rubber. Each car will accommodate thirty-six badly wounded. The hospital train always follows the passenger train, and the utmost care is taken to guard against accidents, and I will state here, that since the commencement of running these improved beautiful carriages, no soldier has sustained the slightest injury. There are attached to the car department a blacksmith's shop, brass and iron foundries, and paint, glass, and upholstery shops, besides a spacious storehouse. The blacksmith shop is upon the same order as the one in the locomotive and machine department, except that it does not employ so many hands. This shop, in connection with the iron foundry, manufactures all the iron work and castings used about a baggage or passenger car and engines. The brass foundry turns out all the articles of this metal required about cars and engines, all of which are handsome specimens of excellent workmanship. The paint, glass, and upholstery shops employ about one hundred hands, who are kept constantly at work at their various trades."

NEW STATIONS, DEPOTS, AND SHOPS.

Frequent references were made in reports of 1865, and at later periods of the decade, to new stations, depots, and repairing and constructing shops. In addition to various others, new West Philadelphia shops and engine houses for use of Pennsylvania Railroad were in progress of erection, and some finished during 1864, including a car shop, 83×280 feet; paint shop, 51×133 feet, two stories; shop for planing and sawing, 67×133 feet; engine and boiler house, 18½×65 feet; machine shop, 83×280 feet; engine house, 18½×65 feet; blacksmith shop, 70×163 feet; boiler shop, 55½×80 feet.

CONSTRUCTION OF ELEVATORS.

During the seventh decade the work of erecting elevators, intended for rapid unloading, storage, and delivery of grain, began to assume increasing importance as an adjunct of railway labors, although some railway companies had constructed elevators ten years earlier. The new elevators were constructed in some instances by railway companies, and in others by independent or affiliated organizations. Under the auspices of the Pennsylvania Railroad Company, an elevator was erected at a wharf on the Delaware, in Philadelphia, about 1865, which was probably the first stationary grain elevator constructed on the Atlantic coast. They had previously been extensively used at various lake ports, especially Toledo and Chicago. Their characteristics are indicated by the fact that the report of the Toledo, Wabash and Western for 1866 says: "The elevators used by our company at Toledo, with a storage capacity of one million four hundred and fifty-two thousand bushels, are now in good repair and efficient working condition, and their present management seems to secure the entire confidence and approbation of all doing business with them. Upon the completion of the track now in process of building through elevator No. 3, the unloading facilities will be fully equal to two hundred and fifty cars daily, which, in emergencies, can be increased to four hundred daily, thus assuring us against delays and detentions in times of a great pressure of business."

RECOGNITION OF THE UTILITY OF SIGNAL STATIONS.

In J. Dutton Steele's report, chief engineer of the Philadelphia and Reading, for 1864, he says: "Fifteen signal stations have been placed upon the main road and Lebanon Valley branch, as a precaution against accidents."

RAILWAY CONSTRUCTION FROM 1870 TO 1879.

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Total United States	5,657.90	6,660.27	7,439.04	5,217.06	2,583.79	1,606.48	2,575.38	2,279.68	2,428.15	5,006.47	41,454 22
I. Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.	212.12	482.75	294.47	270.26	168.40	150.94	39.99	111.61	39.92	59.45	1,829.91
II. New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, and District of Columbia	1,741.85	1,570.93	2,022.84	1,557.65	1,131.14	570.26	743.97	744.07	688.31	720.99	11,492.01
III. Virginia, West Virginia, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, and South Carolina	602.88	530.53	828.34	773.00	284.85	44.10	267.18	150.84	159.92	554.93	4,196.17

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
IV. Illinois, Iowa, Wisconsin, Missouri, and Minnesota	1,915.93	2,937.64	2,434 27	1,555.73	756.60	255.55	541.01	539.65	854.06	1,540 57	13,331.01
V. Louisiana, Arkansas, and Indian Territory.	....	201.97	67.00	35.00	....	88.80	45.00	....	13.50	73.00	524.27
VI. Dakota, Nebraska, Kansas, Texas, New Mexico, Colorado, Wyoming, Montana, Idaho, Utah, Arizona, California, Nevada, Oregon, and Washington	1,185.12	936.45	1,792.12	1,025.42	242.80	496.84	938.23	733.51	672.44	2,057.93	10,080.85

The companies reporting new mileage in 1880 were as follows:—

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
GROUP I. THE NEW ENGLAND STATES.											
Addison	....	15.60	....	....	....	....	....	....	....	....	15.60
Aroostook River	....	....	....	....	....	3.00	12.00	....	....	....	15.00
Ashburnham	....	....	....	2.50	....	....	....	....	....	....	2.50
Attleborough Branch	....	4.00	....	....	....	....	....	....	....	....	4.00
Bangor and Piscataquis	....	8.50	....	....	6.30	....	....	8.00	....	....	22.80
Belfast and Moosehead Lake	33.20	....	....	....	....	....	....	....	....	....	33.20
Bennington and Gastenburg	....	....	8.97	....	....	....	....	....	....	....	8.97
Boston, Barre and Gardner	....	25.16	....	....	10.00	....	1.37	....	....	....	36.53
Boston, Clinton, Fitchburg and New Bedford	21.25	8.60	....	1.34	....	....	2.44	....	....	....	33.63
Boston, Concord and Montreal	21.81	....	14.36	4.79	4.58	....	6.88	....	....	....	52.42
Boston and Lowell	2.27	....	2.50	....	3.16	....	....	....	....	....	7.93
Boston and Maine	....	....	....	43.00	....	....	....	....	....	....	43.00
Boston and New York Air Line	22.27	....	....	28.57	....	....	....	....	....	....	50.84
Boston, Revere Beach and Lynn	....	....	....	....	....	8.62	....	....	....	....	8.62
Boston, Winthrop and Point Shirley	....	....	....	....	....	....	....	1.75	0.85	....	2 60
Bucksport and Bangor	....	....	....	....	18.75	....	....	....	....	....	18.75
Burlington and Lamoille	....	....	....	....	....	....	....	34 43	....	....	34.43
Colchester	....	....	....	....	....	....	....	3 58	....	....	3.58
Concord and Claremont	....	15.73	13.57	....	....	....	....	....	....	....	29.30
Connecticut Central	....	....	....	....	....	20.25	6.80	....	....	....	27.05
Connecticut River	....	3.50	....	....	....	....	....	....	....	....	3.50
Connecticut Valley	....	44.00	1.18	1.00	....	....	....	....	....	....	46.18
Connecticut Western	....	67.60	....	....	....	....	....	....	....	....	67.60
Danbury and Norwalk	4.00	....	6.00	....	....	....	....	....	....	....	10.00
Eastern (of Massachusetts)	....	1.06	5.48	3.96	1.09	....	....	....	....	....	11.59
European and North American	....	56.00	....	....	....	....	....	....	....	....	56.00
Fall River	....	....	....	....	....	12.25	....	....	....	....	12.25
Framingham and Lowell	....	26.12	....	....	....	....	....	....	....	....	26.12
Grafton Centre	....	....	....	....	3.00	....	....	....	....	....	3.00
Holyoke and Westfield	10.32	....	....	....	....	....	....	....	....	4.00	14.32
Hopkinton	....	....	11.45	....	....	....	....	....	....	....	11.45
Knox and Lincoln	....	49.00	....	....	....	....	....	....	....	....	49.00
Lancaster	....	....	8.50	....	....	....	....	....	....	....	8.50
Lewiston and Auburn	....	....	....	....	5.41	....	....	....	....	....	5.41
Lowell and Andover	....	....	....	....	....	10.10	....	....	....	....	10.10
Maine Central	0.70	18.30	....	....	....	....	....	....	....	....	19.00
Manchester and Keene	....	....	....	....	....	....	....	8.71	20.84	....	29.55
Martha's Vineyard	....	....	....	....	8.78	....	....	....	....	....	8.78
Middlesex Central	....	....	....	8.09	....	....	....	....	....	....	8.09
Missisquoi	....	....	28.75	....	....	....	....	....	....	....	28.75
Missisquoi and Clyde Rivers	....	....	....	21.75	....	....	....	....	....	....	21.75
Monadnock	15.80	....	....	....	....	....	....	....	....	....	15.80
Montpelier and Wells River	....	....	....	38.22	....	....	....	....	....	....	32.22
Montpelier and White River	....	....	....	....	....	6.50	....	....	....	....	6.50
Moshassuck	....	....	....	....	....	....	2.00	....	....	....	2.00
Mount Washington	3.33	....	....	....	....	....	....	....	....	....	3.33
Narragansett Pier	....	....	....	....	....	....	8.50	....	....	....	8.50
Nashua, Acton and Boston	....	....	10.20	10.01	....	....	....	....	....	....	20.21
Naugatuck	....	....	....	....	48.39	....	....	....	....	....	48.39
Newburyport City	....	2.08	....	....	....	....	....	....	....	....	2.08
New Haven and Derby	....	13.00	....	....	....	....	....	....	....	....	13.00
New Haven and Northampton	6.15	....	....	....	....	....	....	....	....	....	6.15
Newport and Wickford	....	....	3 40	....	....	....	....	....	....	....	3.40
New York, Housatonic and Northern	....	....	....	....	5.50	....	....	....	....	....	5.50
New York and New England	....	....	26 70	....	....	....	....	....	....	2 46	29.16
New York, New Haven and Hartford	4.31	....	....	....	....	....	....	....	....	....	4.31
North Brookfield	....	....	....	....	4.16	....	....	....	....	....	4.16
Norway Branch	....	....	....	....	....	....	....	....	....	1.36	1.36
Old Colony	....	29.03	19.93	14.26	3.30	7.57	....	....	....	....	74.09
Pawtuxet Valley	....	....	....	....	2.68	....	....	....	....	2 99	5.67
Peterborough	....	....	....	10.77	....	....	....	....	....	....	10.77
Peterborough and Hillsborough	....	....	....	....	....	....	....	....	18.23	....	18.23
Pontiac Branch	....	....	....	....	....	....	....	....	....	4.69	4.69
Portland and Ogdensburg	33.42	25.85	....	11.18	6.07	14.84	....	....	....	....	91.36
Portland and Ogdensburg R. R. Line, Vermont division, comprising—											
Essex County	....	....	7.80	....	....	14.40	....	....	....	....	22.20
Lamoille Valley	....	....	15.40	17.00	4.80	....	....	41.50	....	....	78.70
Montpelier and St. Johnsbury	....	....	19.10	....	....	....	....	....	....	....	19.10
Portland and Rochester	....	20.50	....	....	....	....	....	....	....	....	20.50
Portland and Dover	....	....	....	....	10.88	....	....	....	....	....	10.88
Portsmouth, Great Falls and Conway	28.13	17.12	....	....	....	....	....	....	....	....	45.25
Profile and Franconia Notch	....	....	....	....	....	....	....	....	....	10.00	10.00
Providence and Springfield	....	....	22.80	....	....	....	....	....	....	....	22.80

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Providence and Worcester					7.00						7.00
Rhode Island Central						8.68					8.68
Rhode Island and Massachusetts (in Mass.)								6.62			6.62
Rhode Island and Massachusetts (in R. I.)								7.02			7.02
Rumford Falls and Buckfield										1.50	1.50
Sandy River										18.00	18.00
Shepaug			32.28								32.28
Somerset					13.00	12.05					25.05
Spencer										2.17	2.17
Springfield and New London						7.27					7.27
Springfield and North-eastern		30.50		18.00							48.50
Suncook Valley	0.15										0.15
Troy and Greenfield R. R. and Hoosac Tunnel						7.41					7.41
Union Freight			2.45								2.45
Vermont and Massachusetts		2.82									2.82
Ware River	16.21		33.20.								49.41
Watertown and Waterbury	4.60										4.60
West Amesburg Branch			4.50								4.50
Whitfield and Jefferson										12.28	12.28
Wolfeborough			12.03								12.03
Wood River Branch					5.71						5.71
Woodstock						13.84					13.84
Worcester and Shrewsbury				2.62							2.62
GROUP II. NEW YORK, PENNSYLVANIA, OHIO, MICHIGAN, INDIANA, MARYLAND, DELAWARE, NEW JERSEY, DISTRICT OF COLUMBIA.											
Adirondack	11.00										11.00
Albany and Susquehanna	0.40										0.40
Allegan and South-eastern				11.50							11.50
Allegheny Valley	64.00		7.00	10.20	109.70						190.90
Allentown	4.50										4.50
Alliance and Lake Erie							20.30	3.30		1.40	25.00
Anderson, Lebanon and St. Louis							19.00				19.00
Ashtabula and Pittsburgh				62.60							62.60
Bachman Valley (of Maryland)			5.00								5.00
Bachman Valley (of Pennsylvania)			9.00								9 00
Baltimore and Hanover										20.00	20.00
Baltimore and Ohio		3.00		43.00							46.00
Baltimore, Ohio and Chicago					262.60						262.60
Baltimore and Potomac			88.43	3.00							91.43
Raltimore Short Line					30.20						30.20
Bath and Hammondsport						9.40					9.40
Bedford and Bridgeport				38.70	10.50						49.20
Bedford, Springville, Owensburg and Bloomfield							41.29				41.29
Bellaire and South-western									14.00	28.00	42.00
Bell's Gap				8.30							8 30
Belvidere-Delaware				1.10							1.10
Berlin			8.10								8.10
Berlin Branch								7.00			7.00
Black River and Morristown				7.85	6.10	22.50					36.45
Blairstown								11.33			11.33
Boston, Hoosac Tunnel and Western									20.14	18.87	39.01
Bowling Green						5.50					5.50
Breakwater and Frankford					20.15						20.15
Brooklyn, Flatbush and Coney Island									7.50		7.50
Brooklyn and Montauk			10.92								10.92
Brooklyn and Rockaway Beach									2.65		2.65
Buffalo Creek	4.26										4.26
Buffalo and Erie Basin								0.25			0.25
Buffalo, New York and Philadelphia		53.06	50.80								103.86
Buffalo and South-western						68.39					68.39
Camden, Gloucester and Mount Ephraim					4.00		3.00				7.00
Canada Southern				3.00							3.00
Carbon and Otter Creek Valley				1.60							1.60
Carthage, Watertown and Sackett's Harbor		17.39			12.61						30.00
Catasauqua and Fogelsville				1.00							1.00
Catawissa		31.61				2.96					34.57
Cazenovia, Canastota and De Ruyter	74.50								14.09		28.59
Celina, Van Wert and State Line extension of Columbus and North-western										10.38	10.38
Central of New Jersey			5.40			13.29					18.69
Charlotteburgh and Green Lake					4.25						4.25
Chartiers		22.76									22.76
Chateugay										9.00	9.00
Cherry Valley, Sharon and Albany	20.99										20.99
Chester and Delaware River						4.10					4.10
Chicago and Block Coal			14 00								14.00
Chicago and Canada Southern			24.80	42.80							67.60
Chicago and Grand Trunk	20.25	27.48	74.95	45.35				49.26		20.43	237.72
Chicago, Saginaw and Canada						20.00			4.00	14.00	38.00
Chicago and West Michigan	27.50	115.70	51.20	51.20							245.60
Cincinnati and Baltimore			6.00								6.00
Cincinnati and Eastern							16.00	31.50	10.45	8.63	66.58
Cincinnati and Muskingum Valley		16.30									16.30

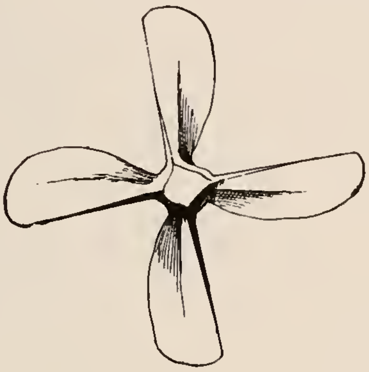
	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Cincinnati and Portsmouth	....	....	....	....	....	....	....	11.20	9.15	....	20.35
Cincinnati, Richmond and Fort Wayne	24.50	61.86	....	....	..	....	....	....	....	....	86.36
Cincinnati, Rockport and South-western	....	....	....	....	....	....	....	....	38.00	....	38.00
Cincinnati and Springfield	....	....	47.80	....	....	....	....	....	....	....	47.80
Cincinnati, Wabash and Michigan	24.30	19.40	14.60	20.00	10.00	....	22.40	....	....	....	110.70
Cincinnati and Westwood	....	....	....	....	....	....	5.63	....	....	....	5.63
Clayton and Theresa	....	....	....	15.87	....	....	....	....	....	....	15.87
Cleveland and Mahoning Valley	8.03	....	....	....	....	....	....	....	....	....	8.03
Cleveland and Marietta	....	35.00	23.00	....	41.33	....	....	....	....	....	99.33
Cleveland, Mount Vernon and Delaware	....	....	38.00	44.54	....	....	....	....	....	....	82.54
Cleveland, Painesville and Ashtabula	....	....	....	....	....	7.65	....	....	....	....	7.65
Cleveland, Tuscarawas Valley and Wheeling	....	....	....	100.54	....	....	....	....	....	....	100.54
College Hill (N. G.)	....	....	....	....	....	....	3.00	3.00	....	....	6.00
Columbia and Port Deposit	....	....	....	....	....	26.60	8.60	....	....	....	35.20
Columbus and Hocking Valley	26.36	....	....	....	....	....	....	10.61	5.45	....	42.42
Columbus, Kinkora and Springfield	....	....	14.18	....	....	....	....	....	....	....	14.18
Columbus and Maysville	....	....	....	....	....	....	....	....	....	19.00	19.00
Columbus, Springfield and Cincinnati	....	....	24.37	....	....	....	....	....	....	....	24.37
Columbus and Toledo	....	....	....	....	....	....	46.00	71.77	....	....	117.77
Columbus, Washington and Cincinnati	....	....	....	....	....	....	....	....	20.18	....	20.18
Connotton Valley	....	....	....	13.70	8.10	....	....	....	....	....	21.80
Corning, Cowanesque and Antrim	....	17.75	19.47	11.10	....	....	....	....	....	....	48.32
Cornwall	....	....	1.16	....	....	....	....	....	....	....	1.16
Crown Point Iron Company	....	....	....	13.00	....	....	....	....	....	....	13 00
Cumberland and Maurice River	....	....	....	21.28	....	....	....	....	....	....	21.28
Dayton and South-eastern	....	....	....	....	....	....	47.70	21.50	....	32.30	101.50
Delaware Bay and Cape May	....	....	....	....	....	....	....	....	....	3.00	3.00
Delaware and Bound Brook	....	....	....	....	....	....	30.70	....	....	....	30.70
Delaware and Chesapeake	20.00	....	....	....	....	....	....	....	....	....	20.00
Delaware and Hudson Canal Company	....	34.35	....	....	....	....	....	....	....	....	34 35
Delaware, Lackawanna and Western	....	....	7.50	....	....	....	....	....	....	....	7.50
Delaware River	....	....	....	20.00	....	....	....	....	....	....	20.00
Delaware Western	....	....	20.00	....	....	....	....	....	....	....	20.00
Detroit and Bay City	....	....	72.00	35.80	5.00	....	3.75	....	12.75	16.75	146.05
Detroit, Grand Haven and Milwaukee	....	....	....	2.00	....	0.65	....	....	....	....	2.65
Detroit, Hillsdale and South-western	....	24.60	40.20	....	.. .	....	....	....	....	....	64.80
Detroit, Lansing and Northern	18.70	101.10	....	21.67	....	....	....	....	9 80	20.31	171.58
Dillsburg and Mechanicsburg	....	....	7.70	....	....	....	....	....	....	....	7.70
Dunkirk, Allegheny Valley and Pittsburgh	54.00	....	36.60	....	....	....	....	....	....	....	90.60
East Brandywine and Waynesburg	....	....	....	....	....	....	12.11	....	....	....	12.11
East Broad Top	....	....	....	10.89	19.50	....	....	....	....	....	30.39
Eastern Ohio	....	....	....	....	7 75	....	....	....	....	....	7.75
Easton and Amboy	....	....	....	....	....	60 00	....	....	....	....	60.00
Edgewood	....	....	....	1.00	....	....	....	....	....	....	1.00
Eel River	....	....	....	....	93.84	....	....	....	....	....	93.84
Elmira State Line	....	....	....	....	....	....	6.25	....	....	....	6.25
Emlenton, Shippenville and Clarion	....	....	....	....	....	....	....	15.00	14.70	....	29.70
Emmettsburg	....	....	....	....	....	7.00	....	....	....	....	7.00
Erie and Genesee Valley	....	12.29	....	....	....	....	....	....	....	....	12.29
Erie and International	....	....	....	....	4.26	....	....	....	....	....	4.26
Evansville and Terre Haute	....	....	....	....	....	....	....	....	...	6.00	6.00
Evansville, Terre Haute and Chicago	....	48.81	....	....	....	....	....	....	....	....	48.81
Evergreen	....	....	....	....	2.61	....	....	....	. ..	....	2.61
Ferro Monte	1.00	....	....	....	....	....	....	....	....	....	1.00
Flint and Pere Marquette	36.00	67.00	40.41	....	48.31	....	....	....	....	....	191.72
Florence Branch	....	2.15	....	....	....	. ..	....	....	....	....	2.15
Flushing, North Shore and Central	....	....	....	8 16	3.99	....	....	....	....	....	12.15
Funda, Johnstown and Gloversville	10.00	....	....	....	....	....	....	....	....	....	10.00
Fort Wayne and Jackson	22.00	42.00	....	....	....	....	....	....	....	....	64.00
Fort Wayne, Muncie and Cincinnati	60.28	....	....	....	....	....	....	....	....	....	60.28
Foxburg, St. Petersburg and Clarion	....	....	....	....	....	....	....	8.40	4.80	....	13.20
Frankford and Holmesburg	4.16	....	....	....	....	....	....	....	....	....	4.16
Frankfort and Kokoma	....	....	....	....	25.40	....	....	....	....	....	25.40
Franklin	....	....	....	8.07	....	....	....	....	....	....	8.07
Frederick and Pennsylvania Line	....	28.00	....	....	....	....	....	....	....	....	28 00
Freehold and Jamesburg Agricultural	....	8.44	....	....	....	....	....	....	....	....	8.44
Freehold and New York	....	....	....	....	....	....	....	12.25	....	1 39	13.64
Garnerville	....	....	....	....	....	0.91	....	....	....	....	0.91
Geneva, Ithaca and Sayre	....	35.88	....	37.45	39.70	....	....	....	....	....	113.03
Geneva and Lyons	....	....	....	....	....	....	....	....	14.00	....	14.00
Glendale and East River	....	....	....	....	....	....	....	....	2.70	....	2.70
Gloversville and Northville	....	....	....	....	....	16.17	....	....	....	....	16.17
Grand Haven	58.40	....	....	. ..	....	....	....	....	....	....	58.40
Grand Rapids and Indiana	163.50	36.10	39.70	53.00	....	....	1.00	....	....	....	293.30
Grand Rapids, Newaygo and Lake Shore	....	....	35.40	....	....	10.20	....	....	....	....	45 60
Grand River Valley	33.08	....	....	....	....	....	....	....	....	....	33.08
Greene	8.10	....	....	....	....	....	....	....	....	....	8.10
Green Lick (N. G.)	....	....	....	....	....	3.50	....	....	....	....	3.50
Greenwich and Johnsonville	15.00	....	....	....	....	....	....	....	....	....	15.00
Hackensack	....	....	....	....	....	....	....	....	6 25	....	6.25
Hanover and York	....	....	....	....	10.00	8.60	....	....	....	....	18.60
Harlem River and Port Chester	....	....	....	11.55	....	....	....	....	....	....	11.55
Harrisburg and Potomac	....	....	....	6.75	7.30	3.80	5.73	3.55	....	....	27.13
Hibernia Underground	....	....	....	....	....	....	....	....	....	1.00	1.00

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
High Bridge							17.42				17.42
Hobart and Manistee River										9.24	9.24
Huntingdon and Broad Top Mountain								1.25			1.25
Indiana Block Coal										14.00	14 00
Indianapolis, Decatur and Springfield				85.00			15.00				100 00
Indianapolis, Delphi and Chicago									27.00	11.55	38.55
Indianapolis and St. Louis	71.84										71 84
Iron				3.50							3.50
Ithaca, Auburn and Western			26.57								26 57
Jackson, Lansing and Saginaw		39.73		82.80							122 50
Jamestown and Franklin	8.00										8.00
Jefferson	36.69										36.69
Jeffersonville, Madison and Indianapolis	1.48										1.48
Jersey City and Albany					12 10					14.10	26.20
Junction and Breakwater	15.00								5.00		20.00
Kalamazoo and South Haven	40.00										40.00
Karns City and Butler							17.00				17.00
Kendall and Eldred									15.00		15.00
Kent County	5.00	5.00									10.00
Keystone Coal				5.50							5.50
Kingan (unincorporated)				0.42							0.42
King's County Central								3.25			3.25
Lake Erie, Evansville and South-western				17.00							17.00
Lake Erie and Western	116.40		22.10		9.20		84.60	9.20		53.50	295.00
Lake George and Muskegon River							7.00	4 00		7.13	18.13
Lake Ontario and Southern			25.00	8.60							33.60
Lake Shore and Michigan Southern		1.50	38 31								39.81
Lancaster and Reading						15.22					15.22
Lawrence					4 06						4.06
Lehigh Coal and Navigation	2.00						10.50		3.00		15.50
Lehigh and Lackawanna									10.00		10.00
Lehigh Valley		8.80									8.80
Lewisburg and Tyrone			9.20		7.90			24 82			41.92
Ligonier Valley								10.50			10.50
Littles Town		2.40									2.40
Lockport and Buffalo										13 89	13.89
Long Branch and Sea Girt						3.40					3 40
Long Island			2.02								2.02
Longwood Valley							13 26				13.26
Louisville, New Albany and St. Louis		10.00		18.00							28.00
McKean and Buffalo						22.15					22.15
Mahoning Coal				43.40							43 40
Marine									2.00		2.00
Marquette, Houghton and Ontonagon	2.08		46.78								48.86
May's Landing and Egg Harbor City			7.00								7.00
Menominee River									24.71		24.71
Metropolitan Elevated							3.17		2.24	11.25	16.66
Michigan Air Line Railroad	69.44	45.28									114.72
Michigan Air Line Railway										12 00	12 00
Michigan City and Indianapolis	12.75										12.75
Michigan, Midland and Canada				15.00							15.00
Middletown and Crawford			10.22								10.22
Midland (of New Jersey)			71.10								71.10
Mineral Range				12.50							12.50
Mont Alto			10.25							7.62	17.87
Montour										11.00	11.00
Montrose			20.26	2.64	3.35		0.93				27.18
Morris and Essex				34.54							34.54
Mount Pleasant and Broad Ford		9.70									9.70
Muncy Creek			6.00								6.00
Muskegon River and Rose Lake									7.50		7.50
Nesquehoning Valley	16.50	1.12									17.62
Newark and Delaware City				20.24							20.24
Newark and Hudson		5.62									5.62
Newark, Somerset and Straitsville			44.00								44.00
New Castle and Franklin				22.60	13.40		1.65				37.65
New Egypt and Farmingdale						7.43					7.43
New Jersey and New York					4.50	25.00					29.50
Newtown and Flushing					3.97						3.97
New York, Bay Ridge and Jamaica										8.16	8.16
New York, Boston and Montreal									3.95		3.95
New York and Canada		9 25			32.74	50.88	14.25				107.12
New York Central and Hudson River		7.83									7.83
New York Central and Niagara River								2.81			2.81
New York and Coney Island										2.41	2.41
New York Elevated		3.50		0.25			1.25	0.26	8 72	1.35	15.35
New York and Greenwood Lake				2.60	40.00						42.60
New York and Harlem		6.95									6.95
New York and Long Branch						23.35					23.35
New York and Manhattan Beach								5.44			5.44
New York, Ontario and Western	110.60	54 00	43 60	37.00							244.60
New York, Pennsylvania and Ohio			1.58								1.58
New York and Rockaway			8.91								8.90
New York and Sea Beach								3.74		2.26	6.01

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
North-east Pennsylvania		9.56									9.56
North Pennsylvania							20.60				20.60
Northern Central Michigan			42.00	19.14							61.14
North-western Ohio							79.17				79.17
Nyack and Northern	4.38										4.38
Ogdensburg and Morristown									10.67		10.67
Ohio Central										49.43	49.43
Ohio and Mississippi	53.31		224.86								278.17
Oil City and Ridgway	6.00										6.00
Olean, Bradford and Warren (in New York)									12.53		12.53
Olean, Bradford and Warren (in Pennsylvania)									10.43		10.43
Painesville, Canton and Bridgeport									5.00		5.00
Painesville and Youngstown			11.10	2.00	39.20	9.50					61.80
Parker and Karns City					10.50						10.50
Passaic and Delaware			14.02								14.02
Paulding and Cecil									4.50		4.50
Peach Bottom				15.00	21.00	7.00	7.00	4.50			54.50
Pemberton and Sea Shore	18.08										18.08
Pennsylvania		19.95	3 00	22.42	0.82		1.34	1.89			49.42
Pennsylvania (in Maryland)										6.25	6.25
Pennsylvania and New York	8.44										8.44
Peoples			3.47								3.47
Perkiomen			7.11		4.83		15.59				27.53
Philadelphia and Atlantic City								54.50			54.50
Philadelphia, Newtown and New York						6.60	1.40		13.60		21.60
Philadelphia and Reading			1.70								1.70
Pickering Valley		11.00									11.00
Pinconning									12.10	3.10	15.20
Pittsburgh and Castle Shannon		6 00									6.00
Pittsburgh and Connellsville		89.10									89.10
Pittsburgh and Lake Erie									68.74		68.74
Pittsburgh Southern								12.50	9.02	13.60	35.12
Pittsburgh, Titusville and Buffalo		16.30									16.30
Pittsburgh, Virginia and Charleston				30.00							30.00
Pittsburgh and Western									30.00	4.50	34.50
Pittsburgh and Dannemora									15.92		15.92
Plymouth	6.25										6.25
Pomeroy and State Line				21.26							21.26
Port Huron and North-western										26 00	26.00
Port Jervis and Monticello	12.00	11.75									23.75
Poughkeepsie, Hartford and Boston	23.71		17.99								41.70
Prospect Park and Coney Island	0.26	2.75				5.61					8.62
Queen Anne and Kent	21.00										21.00
Reading and Columbia			0.84			1.33					2.17
Reading and Lehigh					41.20						41.20
Rensselaer and Saratoga										0.59	0.59
Rhinebeck and Connecticut					28.00	7.20					35.20
Rochester and Lake Ontario										6.05	6.05
Rochester and State Line					25.15			18.56	10.51	53.47	107.69
Rome and Clinton			12.88								12.88
Rome, Watertown and Ogdensburg		40.00	45.50	12.00		42.00	52.95				192.45
Saginaw and Clare County										8.91	8.91
Saginaw and Grand Rapids										3.60	3.60
Saginaw and Mt. Pleasant										15.02	15.02
Saginaw Valley and St. Louis				29.00							29.00
St. Clairsville								6.65			6.65
Salisbury						2.57	3.16		2.92	2.03	10.68
Saratoga and Schenectady	2.16										2.16
Schenectady and Duanesburg		3.00	10.79								13.79
Scioto Valley							47.01	50.19			97.20
Sharon			4.00				7.76				11.76
Sharpsville								11.80			11.80
Shenango and Allegheny			10.70			13.80					24 50
Silver Lake			6.50								6.50
Smithtown and Port Jefferson				19.01							19.01
Smyrna and Delaware Bay		22.00									22.00
Somerset and Cambria		8.81									8.81
South Mountain	17.00										17.00
South-west Pennsylvania				24.40		5.20	7.70	4.60	2.96		44.86
Southern Central	66.50	49.40									115.90
Southern Hempstead Branch	5.42										5.42
Southern Pennsylvania		21.40	1.90								23.30
Spring Brook				8.25							8.25
Springfield Southern								61.90	47.00	4.55	113.45
Springville and Sardinia									12.00		12.00
Spuyten Duyvil and Port Norris			6.05								6.05
Stewart Line (unincorporated)			16.34								16.34
Stony Creek				11.15							11.15
Sunbury, Hazleton and Wilkes-Barre	43.44										43.44
Sunbury and Lewistown		43.33									43.33
Suspension Bridge and Erie Junction	23.28										23.28
Sussex	6.20										6.20
Syracuse, Chenango and New York		12.00	14.00		17.49						43.49
Syracuse, Geneva and Corning								57.75			57.75

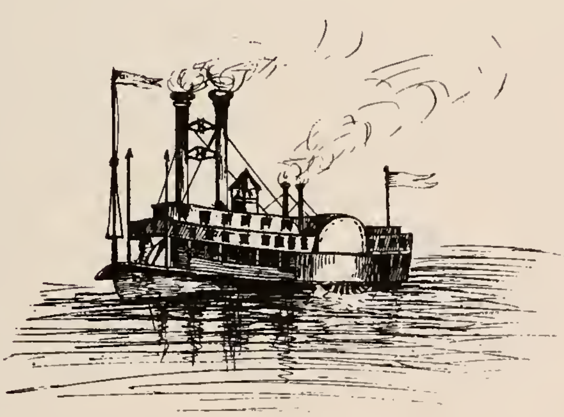
Small Steamboat of Southern Atlantic Waters.

Ocean Side-Wheel Steamer of 1850.

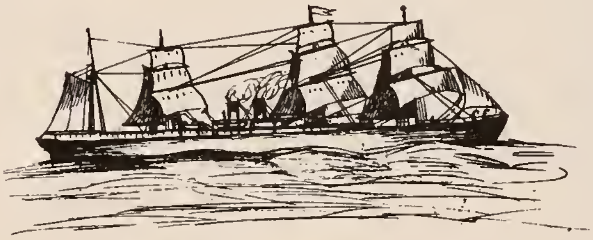


Screw Propeller.

Tug-Boat Propeller.



Mississippi Side-Wheel Steamer.



Modern Ocean Steamer.

IMPROVEMENTS IN STEAM NAVIGATION.

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Tawas and Bay County	....	....	....	....	....	....	....	....	21.00	....	21 00
Terre Haute and Indianapolis	28.68	....	....	....	....	....	....	....	....	....	28.68
Terre Haute and Logansport	....	....	95.12	....	....	....	....	....	....	....	95.12
Terre Haute and South-eastern	....	....	....	26.00	....	....	....	....	....	14.00	40.00
Tioga	....	....	....	....	....	....	13.80	....	....	....	13.80
Toledo and Ann Arbor	....	....	5.00	....	....	....	....	....	39.70	....	44.70
Toledo, Canada Southern and Detroit	....	....	....	55.87	....	....	....	....	....	....	55.87
Toledo, Delphos and Burlington	....	....	....	....	9.13	....	....	42.00	56.10	48.30	155.53
Toledo and Grand Rapids	....	....	....	....	....	....	....	5.80	....	....	5.80
Toledo and South Haven	....	....	....	....	....	....	....	9.00	....	....	9.00
Tom's River and Watertown	....	....	15.00	....	....	....	....	....	....	....	15.00
Traverse City	....	....	26.00	....	....	....	....	....	....	....	26.00
Tresckow	....	....	6.50	....	....	....	....	....	....	....	6.50
Tuckerton	....	29.00	2.00	....	....	....	....	....	....	....	31.00
Tyrone and Clearfield	2.21	....	3.83	6.54	....	....	....	....	....	....	12.58
Ulster and Delaware	20.62	25.61	15.00	....	....	....	....	....	....	....	61.23
Union (of Baltimore)	....	....	....	6.05	....	....	....	....	....	....	6.05
Union R. R. Transfer & Stock Yard (of Indianapolis)	....	....	....	....	....	....	....	12.10	....	....	12.10
Utica and Black River	....	15.50	....	12.97	....	....	....	....	....	....	28.47
Utica, Shenango and Susquehanna Valley	43.51	....	7.62	....	....	....	....	....	....	....	51.16
Utica, Clinton and Binghamton	....	....	31.30	....	....	....	....	....	....	....	31.30
Utica, Ithaca and Elmira	10.00	26.50	13 00	3.50	....	12.80	....	....	....	....	65.80
Valley Railroad	....	11.64	....	....	....	....	....	....	....	....	11.64
Valley Railway	....	....	....	....	....	....	....	....	10.00	48.70	58.70
Vineland	....	47.50	....	....	....	....	....	....	....	....	47.50
Walkill Valley	5.83	6.77	7.93	....	....	....	....	....	....	....	20.53
Washington City and Point Lookout	....	....	12.50	....	....	....	....	....	....	....	12.50
Watchung	....	....	....	....	....	....	4.00	....	....	....	4.00
Waynesburg and Washington	....	....	....	....	....	....	....	27.93	....	....	27.93
West End	....	....	....	....	....	....	....	....	1.55	....	1 55
West Troy and Green Island	....	....	....	1.08	....	....	....	....	....	....	1.08
Western Maryland	....	14.10	27.20	17.10	....	....	....	....	....	....	58.40
Western Pennsylvania	21.05	....	....	....	....	....	....	....	....	....	21.05
Wheeling and Lake Erie	....	....	....	....	....	....	....	12.50	....	....	12.50
Wicomico and Pocomoke	....	....	....	....	7.00	....	....	....	....	....	7.00
Williamstown	....	....	9.50	....	....	....	....	....	....	....	9.50
Wilmington and Northern	30.50	....	....	....	6.40	....	....	....	....	....	36.90
Worcester	....	....	14.00	....	....	18.00	4.00	....	....	....	36.00
Worcester and Somerset	....	....	....	9.00	....	....	....	....	....	....	9.00
Youghiogheny	....	1.25	....	6.75	2.00	....	....	....	....	....	10.00
GROUP III. VIRGINIA, WEST VIRGINIA, KENTUCKY, TENNESSEE, MISSISSIPPI, ALABAMA, GEORGIA, FLORIDA, NORTH CAROLINA, SOUTH CAROLINA.											
Alabama Central	....	....	....	....	....	....	....	....	14.00	....	14.00
Alabama Great Southern	89 00	83 00	....	....	....	....	....	....	....	....	165.00
Alexandria and Fredericksburg	....	....	32.27	....	....	....	....	....	....	....	32.27
Ashley River	....	....	....	....	....	....	....	....	3.50	....	3 50
Atlanta and Charlotte Air Line	20.00	33.00	109.31	107.32	....	....	....	....	....	....	269 63
Brunswick and Albany	....	171.00	....	....	....	....	....	....	....	....	171.00
Cape Fear and Yadkin Valley	....	....	....	....	....	....	....	....	....	3.50	3.50
Carolina Central	....	....	....	25.00	29.00	....	....	....	....	....	54.00
Cheraw and Chester	....	....	....	....	....	....	....	12 00	....	11.00	23.00
Cherokee Iron	23.00	....	....	....	....	....	....	....	....	14.00	37.00
Chesapeake and Ohio	....	....	....	197.71	1.75	....	....	1.42	....	....	200.88
Chester and Lenoir (N. G.)	....	....	....	....	....	....	26.60	....	....	....	26.60
Chicago, St. Louis and New Orleans	....	....	....	106 60	18.02	....	....	....	....	....	124.62
Cincinnati Southern	....	....	....	....	....	....	135.30	25.92	4.94	165.30	331.46
Clarksburg, Weston and Glenville	....	....	....	....	....	....	....	....	....	26.25	26.25
Columbus and Rome	....	....	20.00	....	....	....	....	....	....	8.00	28.00
Cumberland and Ohio	....	....	....	....	....	....	....	....	....	30.50	30.50
Duck River Valley (N. G)	....	....	....	....	....	....	5.00	15.00	....	6.00	26.00
East Alabama and Cincinnati	....	26 00	....	....	....	....	....	....	....	....	26.00
Eastern Kentucky	11.00	....	....	....	11.15	....	....	....	....	....	22.15
Elberton Air Line	....	....	....	....	....	....	....	....	49.86	....	49.86
Elizabethtown, Lexington and Big Sandy	....	....	33.60	....	....	....	....	....	....	....	33.60
Georgia Railroad and Banking	....	....	74 25	....	....	....	....	....	....	....	74.25
Georgia Southern	38.00	....	....	....	....	....	....	....	....	....	38.00
Glasgow	10 50	....	....	....	....	....	....	....	....	....	10.50
Greenville, Columbus and Birmingham	....	....	....	....	....	....	....	....	10.00	....	10.00
Hartwell	....	....	....	....	....	....	....	....	....	10.00	10.00
Jacksonville, Pensacola and Mobile	....	20.00	....	....	....	....	....	....	....	....	20.00
Jamesville and Washington	....	....	....	....	....	....	....	22.00	....	....	22.00
Licking Valley	....	....	....	....	....	....	5.50	....	11.50	....	17.00
Louisville Bridge	1.00	....	....	1.25	....	....	....	....	....	....	2.25
Louisville, Harrod's Creek and Westport	....	....	....	....	....	11.00	....	....	....	....	11.00
Louisville and Nashville	....	....	....	....	46.00	....	....	....	....	73.00	119.00
Louisville Railway Transfer	....	....	4.13	....	....	....	....	....	....	....	4.13
Louisville and Wadley	....	....	....	....	....	....	....	....	....	10.00	10.00
Marietta and North Georgia	....	....	....	....	....	....	....	....	....	23.85	23.85
Martinsburg and Potomac	....	....	....	11.80	....	....	....	....	....	....	11.80
Maysville and Lexington (Northern division)	....	....	....	50.00	....	....	....	....	....	....	50.00
Memphis, Paducah and Northern	59.37	....	....	52.00	....	....	....	....	....	....	111.37
Milton and Sutherlin (N. G.)	....	....	....	....	....	....	....	....	7.00	....	7.00
Mississippi Valley and Ship Island	....	....	10.00	....	....	....	....	....	....	....	10.00

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Mobile and Alabama Grand Trunk	....	20.00	36.25	....	....	....	17.42	....	....	....	56 25
Mobile and Girard	12 00	....	....	....	....	....	....	....	....	....	12.00
Mobile and Montgomery	....	....	17.00	....	....	....	....	....	....	....	17.00
Mobile and North-western	....	....	....	....	....	....	....	8.00	8.00	13.71	29.71
Mobile and Ohio	9 00	....	....	....	11.10	....	....	....	....	....	20.10
Montgomery and Eufaula	40.00	....	....	....	....	....	....	....	....	....	40.00
Mount Sterling Coal Road	....	....	....	....	....	20.00	....	....	....	....	20.00
Nashville, Chattanooga and St. Louis	29.00	....	....	....	....	....	....	7.50	....	....	36.50
Nashville and Tuscaloosa	....	....	....	....	....	....	....	....	....	20 90	20.90
Natchez, Jackson and Columbus	....	....	....	....	....	....	26.00	....	8.00	9.00	43.00
New Orleans and Selma	....	....	....	20 00	....	....	....	....	....	....	20.00
Newport and Cincinnati Bridge	....	....	0.74	....	....	....	....	....	....	....	0.74
Norfolk and Ocean View	....	....	....	....	....	....	....	....	....	8 02	8.02
North-eastern (of Georgia)	....	....	....	....	....	....	40.00	....	....	....	40 00
North-western North Carolina	....	....	....	25 57	....	....	....	....	....	....	25.57
Paducah and Elizabethtown	42 80	67.20	75 70	....	....	....	....	....	....	....	185.70
Peninsula	....	....	....	....	....	....	....	....	....	20 00	20.00
Pennsburgh and Harrisville	....	....	....	....	....	9 00	....	....	....	....	9.00
Pensacola and Mobile	....	....	5 00	. . .	....	....	....	....	....	....	5.00
Pensacola and Selma	....	40.00	....	....	....	....	....	....	....	....	40.00
Pine Hill	....	....	....	....	....	....	3.50	....	....	....	3.50
Pittsburgh, Wheeling and Kentucky	....	....	....	....	....	....	....	....	24 26	....	24.26
Port Royal and Augusta	....	....	....	112 00	....	....	....	....	....	....	112.00
Potomac	....	....	1 70	....	....	....	....	....	....	....	1.70
Potomac, Fredericksburg and Piedmont	....	....	17 50	....	....	....	20 00	....	....	....	38.00
Pratt Coal and Coke	....	....	....	....	....	....	....	....	5.06	2.00	7.06
Raleigh and Augusta Air Line	....	....	....	....	....	....	....	54.00	....	....	54.00
Richmond and Danville	0.87	....	4 35	....	....	....	1.45	....	....	....	6.67
Richmond, Fredericksburg and Potomac	....	....	10 00	....	....	....	....	....	....	....	10.00
Richmond, Fredericksburg and Potomac and Richmond and Petersburg Railroad Connection	1.25	....	....	....	....	....	....	....	....	....	1.25
Roane Iron	5.50	....	....	....	....	....	....	....	....	....	5.50
St. John's (of Florida)	....	....	....	14.50	....	....	....	....	....	....	14.50
St. Louis and South-eastern (Kentucky division)	....	....	98.09	....	....	....	....	....	....	....	98.09
Sandersville and Tennile	....	....	....	....	....	....	3.33	....	....	....	3.33
Savannah, Florida and Western	34.10	....	....	....	....	4.10	....	....	....	....	38.20
Savannah, Griffin and North Alabama	35 00	....	25.00	....	....	....	....	....	....	....	60.00
Savannah and Memphis	....	22.00	18.00	1.75	18.25	....	....	....	....	....	60.00
Savannah, Skidaway and Seaboard	6 25	....	4.87	....	....	....	....	....	....	....	11.12
Selma and Greensborough	21.64	....	....	....	....	....	....	....	....	8.00	29.64
Shelby	18.60	....	....	....	....	....	....	....	....	....	18.60
Shenandoah Valley	....	....	....	....	....	....	....	....	....	42.00	42.00
Ship Island, Ripley and Kentucky	....	....	25 00	....	....	....	....	....	....	....	25.00
South and North Alabama	....	....	182.58	....	....	....	....	....	6.30	....	188.88
South-western (of Georgia)	....	....	....	47 50	....	....	....	....	....	....	47 50
South-western (of Kentucky)	....	....	....	....	....	....	....	5.00	....	....	5.00
Spartanburg and Asheville	....	....	....	....	....	....	....	....	....	49.50	49.50
Tuskegee	....	5.33	....	....	....	....	....	....	....	....	5.33
Valley (of Virginia)	....	....	....	....	25.78	....	....	....	....	....	25.78
Vicksburg and Brunswick	....	....	21 00	....	....	....	....	....	....	....	21.00
Vicksburg and Meridian	....	....	2 00	....	....	....	....	....	....	....	2.00
Washington City, Virginia Midland and Great South.	....	....	....	....	114 30	....	....	....	7.50	....	121.80
Washington and Ohio	....	....	....	....	6.50	....	....	....	....	....	6.50
Western (of Alabama)	50 00	....	....	....	....	....	....	....	....	....	50.00
Western North Carolina	33.00	....	....	....	3.00	....	....	....	....	....	36.00
Wilmington, Columbia and Augusta	....	43.00	....	....	....	....	....	....	....	....	43.00
Winchester and Strasburg	19.00	....	....	....	....	....	....	....	....	....	19.00
GROUP IV. ILLINOIS, IOWA, WISCONSIN, MISSOURI, MINNESOTA.											
Albia, Knoxville and Des Moines	....	....	....	....	....	....	....	....	....	32.89	32.89
American Central	....	50.59	....	....	....	....	....	....	....	....	50.59
Belleville and Eldorado	....	....	....	....	....	....	....	....	30.90	18 77	49.67
Belleville and Southern Illinois	42.17	....	....	....	....	....	. . .	....	....	....	42.17
Brunswick and Chillicothe	....	38.00	....	....	....	....	....	....	....	....	38.00
Burlington, Cedar Rapids and Northern	....	196 00	80.00	93.80	....	....	....	32.00	....	....	401.80
Burlington and North-western	....	....	....	....	....	....	19 67	....	....	18.55	38.22
Burlington and South-western	....	59.60	39.80	15.00	....	....	27.90	....	....	....	142.30
Cairo and St. Louis	....	....	....	90.00	....	56.50	....	....	....	....	146.50
Cairo and Vincennes	....	....	157.30	....	....	....	....	....	....	....	157.30
Caledonia, Mississippi and Western	....	....	....	....	....	....	....	....	....	47.71	47.71
Carbondale and Shawneetown	....	17.50	....	....	....	....	....	....	....	....	17.50
Cedar Falls and Minnesota	8.48	....	....	....	....	....	....	....	....	....	8.48
Cedar Rapids and Missouri River	2.60	....	....	....	....	....	....	....	....	....	2.60
Central Iowa	125.50	20.14	1.50	....	....	....	....	....	....	....	147.14
Central (of Minnesota)	....	....	....	....	40.00	....	....	....	....	....	40.00
Champaign, Havana and Western	....	....	....	....	131.00	....	....	....	....	....	131 00
Charlton, Des Moines and Southern	....	....	....	....	....	....	....	....	....	32.83	32.83
Chatfield	....	....	....	....	....	....	....	....	11.46	....	11.46
Cherry Valley	....	....	....	....	....	....	....	....	6.50	....	6.50
Chicago and Alton	45.00	36.80	....	....	....	23.86	3.98	....	....	....	109.64
Chicago, Bellevue, Cascade and Western	....	....	....	....	....	....	....	....	....	35.70	35.70
Chicago, Burlington and Quincy	39.12	44 54	36.72	....	....	....	....	....	....	....	120 38
Chicago, Clinton, Dubuque and Minnesota	....	53.50	125.70	....	....	....	28.90	....	....	....	208.10
Chicago, Clinton and Western	....	....	....	....	....	....	....	....	9.65	....	9.65

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Chicago and Dakota										46.39	46.39
Chicago and Eastern Illinois	27.95	46 60		24.00							98.55
Chicago and Iowa			80.00								80.00
Chicago, Milwaukee and St. Paul	366.48	172.86	197.64			1.93				333.42	1,072.33
Chicago and North-western	44.90	69.87	74.73	133.60	0.70		1.20				325.00
Chicago and Pacific							88.00				88.00
Chicago, Pekin and South-western		20.00			37.50		28.00				85.50
Chicago, Rockford and Northern						23.00					23.00
Chicago, Rock Island and Pacific		272.11	105.46		7.51	25.14	25.00	17.00	36.38	9.00	497.60
Chicago and Rock River		46.80									46.80
Chicago, St. Paul, Minneapolis and Omaha	45 50	62 70	32.20		23.00				32.00	6.00	201.40
Chicago and Springfield		111.47									111.47
Chicago and Tomah									30 50	13 50	44 00
Chippewa Falls and Western					10.35						10.35
Cincinnati, La Fayette and Chicago		56.30									56 30
Clarinda and St. Louis										11.25	11.25
Clinton, Bloomington and North-eastern										14.12	14.12
Council Bluffs and St. Louis										66 75	66.75
Creston and Northern										27.70	27.70
Crooked Creek							8.50				8.50
Crystal City										4.00	4 00
Danville, Olney and Ohio River									8.00		8.00
Danville and South-western			35.40		35.20		32.50				103.10
Dent and Phelps								3.88			3.88
Des Moines, Adel and Western								7.00	21.80		28.80
Des Moines and Fort Dodge	14.40										14 40
Des Moines and Knoxville										34 92	34.92
Des Moines and Minneapolis					37.00				21.00		58.00
Dixon, Peoria and Hannibal	44.49										44.49
Dixon and Quincy		6.23									6.23
Dubuque and Dakota										40 91	40.91
Dubuque, Platteville and Milwaukee	8.00										8.00
East St. Louis and Carondelet				11.50							11.50
East St. Louis Connecting										1.02	1.02
Fond du Lac, Amboy and Peoria								30.00			30.00
Fort Dodge and Fort Ridgely									10.50	17.90	28.40
Fort Madison and North-western										12.00	12 00
Galena and Wisconsin					31.50			8.50			40.00
Grayville and Mattoon							20.00	32.70		18 00	70.70
Green Bay and Minnesota		39.30	108.80	61.20	3.00		6.50				218.80
Grinnell and Montezuma						13.62					13.62
Hannibal Bridge		2 94									2.94
Hannibal and St. Joseph			19.47								19.47
Havana, Rantoul and Eastern							40.00	12.00	23 50		75.50
Illinois Grand Trunk			62.43								62.43
Illinois Midland			70.80		74.10						144.90
Illinois and St. Louis		8.00	2.36		0.61						11.00
Iowa City and Western										57.50	57.50
Iowa Eastern			19.70								19.70
Iowa Falls and Sioux City	134.80										134.80
Iowa Midland		68.80									68.80
Iowa Railway Coal and Manufacturing					3.50						3.50
Jacksonville South-eastern	18.37	12.31									30.68
Kankakee and South-western									36.76	8.49	45.25
Kankakee and Western										21.99	21.99
Kansas City and Eastern					11.00	32.00					43.00
Kansas City, St. Joseph and Council Bluffs	16.76	1.22		5.20							23.18
Kansas City, St. Louis and Chicago									162.62		162.62
Keokuk and St. Paul	41.86										41.86
Leon, Mount Ayr and South-western										35 25	35.25
Little River Valley and Arkansas								26.60			26.60
Louisiana and Missouri River		51.00	49.80								100.80
Lyndale										4.50	4.50
Maple River								60.15		12.76	72.91
Milwaukee Cement								1.20			1.20
Milwaukee, Lake Shore and Western		21.40	68.50	25.20	7.20		21.00		15.70	31.10	190.10
Milwaukee and Northern	13.70		32.50	73 50							119.70
Minneapolis and Duluth		13.10									13.10
Minneapolis and St. Louis		27.20						93.36		13.60	134.16
Minnesota and Iowa Southern										20.10	20.10
Minnesota Midland									59.00		59.00
Minnesota Valley									24.40		24.40
Mississippi River Bridge		1.30									1.30
Missouri, Iowa and Nebraska		51.00	34 00						5.00	28.00	118.00
Missouri, Kansas and Texas	185.00	212.80	247 00	142 00							786.00
Missouri Pacific			11.00								11.00
Moline and South-eastern (N. G.)										8.00	8.00
Nebraska City, Sidney and North-eastern									20.87		20.87
North-western Union				62.63							62.63
Oshkosh and Mississippi River			20.00								20.00
Ottawa, Oswego and Fox River Valley		68.37									68.37
Peoria, Decatur and Evansville		67.90	32.70								100.60
Peoria and Hannibal	62.67										62.67
Peoria and Springfield			9.00								9.00

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Pine River Valley and Stevens Point							16.00				16.00
Plainview									15.01		15.01
Prairie du Chien and McGregor					2.09						2.00
Quincy, Alton and St. Louis			46.36								46.36
Quincy, Missouri and Pacific		44.69	23 31								68.00
Rochester and Northern Minnesota									21.48		21.48
Rock Island and Mercer County							21.80				21.80
Rock Island and Peoria		79.50									79.50
St. Charles		2.40									2.40
St. Joseph and Des Moines									25.00	25.00	50.00
St. Joseph and St. Louis	76.25										76.25
St. Louis Bridge					1.22						1.22
St. Louis, Council Bluffs and Omaha		41.75									41.75
St. Louis, Hannibal and Keokuk						31.00			13.50		44.50
St. Louis, Iron Mountain and Southern	0.75			329.50	141.50						474.75
St. Louis, Keokuk and North-western			35.00	25.00	30.00						90.00
St. Louis and Lexington	55.00										55.00
St. Louis, Ottumwa and Cedar Rapids		43.50									43.50
St. Louis, Rock Island and Chicago		287.53									287.53
St. Louis, Salem and Little Rock			12.75	28.25							41.00
St. Louis and San Francisco	105.53	39.00		44.50			29.00	41.44	12.65		272.22
St. Louis and South-eastern			208.00								208.00
St. Louis, Vandalia and Terre Haute	58.30										58.30
St. Paul and Duluth	75.00										75.09
St. Paul, Minneapolis and Manitoba	30.40	82 90	133.50			11.00		33.60	103.45	91.70	486.55
St. Paul and Sioux City	23.00	56.00	67.51				29.67	8.00	21.00	106.00	311.18
St. Paul, Stillwater and Taylor's Falls		23.80									23.80
Salem and South-eastern				1.25							1.25
Salisbury and Glasgow							15.75				15.75
Sheboygan and Western		35.40									35.40
Southern Minnesota	82.50										82.50
Southern Minnesota Railway Extension									43.00	94.00	137.00
Springfield and North-western					45.20						45.20
Springfield and Western Missouri									20.00		20.00
Stanwood and Tipton			8.50								8.50
State Line and Union		8.70									8.70
Stillwater and St. Paul	12 57										12.57
Toledo and North-western		3.00									3.00
Toledo, Peoria and Warsaw		10.30									10.30
Tunnel (of St. Louis)					0.91						0.91
Union Depot (of Kansas City, Mo.)								0.28			0.28
Union Depot (of St. Louis, Mo.)										0 50	0.50
Union Railway and Transit (of St. Louis)					2.00						2.00
Viroqua										32.20	32.20
Wabash, Chester and Western			40.83						1.43		42.26
Wabash, St. Louis and Pacific	152.78	6.17		158.00	8.47		12.50	8.50		88.25	434.67
Waukon and Mississippi								23.00			23.00
West End (N. G.)						5.00	3.00		8.00		16.00
Western (of Minnesota)								60.54			60.54
Winona, Mankato and New Ulm		3.75									3.75
Winona and St. Peter	11.00	23.00	30.00		158.00						222.00
Wisconsin Central		63.00	74.00	54.00			123.54	10.00			324.54
Wisconsin Valley				46.60	42.10			1.00		18.30	108.00
GROUP V. LOUISIANA, ARKANSAS, INDIAN TERRITORY.											
Arkansas Midland			48.00								48.00
Atlantic and Pacific		33.87									33.87
Brinkley and Cotton Plant									8.00		8.00
Hot Springs						25.00					25.00
Iron Mountain and Helena										19.00	19.00
Little Rock and Fort Smith		50.10	15 00	35.00		20.00	45.00				165.10
Little Rock, Mississippi River and Texas						43.80				44.00	87.80
Memphis and Little Rock		46.00	4.00								50.00
Morgan's Louisiana and Texas		72.00							5.50		77.50
Vidalia and Western										10.00	10.00
GROUP VI. DAKOTA, NEBRASKA, KANSAS, TEXAS, NEW MEXICO, COLORADO, WYOMING, MONTANA, IDAHO, UTAH, VIRGINIA, CALIFORNIA, NEVADA, OREGON, WASHINGTON.											
Amador Branch							27.20				27.20
Atchison, Colorado and Pacific										192.00	192.00
Atchison, Jewell County and Western										33.64	33.64
Atchison and Nebraska			146.60								146.60
Atchison, Topeka and Santa Fe	34 93	73.33	217.96	118.05							444.27
Bay and Coast									24.10		24.10
Berkeley Branch							3.76		0.08		3.84
Bingham Cañon and Camp Floyd			16.40								16.40
Burlington and Missouri River (in Nebraska)			190 50								190.50
California Pacific	113.51										113.51
Central Pacific	69.02	39.19	172.38								280.59
Colorado Central	15.55							142.04	11.12		168.71
Colorado Central (of Wyoming)								8.64			8.64
Corpus Christi, San Diego and Rio Grande (N. G.)								12.00	13.00	15.00	40.00

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Covington, Columbus and Black Hills	....	....	....	....	....	....	26 00	....	....	....	26.00
Cowley, Sumner and Fort Smith	....	....	....	....	....	....	...	....	67.62	....	67.62
Dakota Central	...	....	....	....	....	....	....	....	....	24.51	24.51
Dallas and Wichita	....	....	....	....	17.00	....	....	....	...	...	17.00
Denver and Boulder Valley	14.50	....	12.49	....	....	....	....	.	...	....	26.99
Denver and Rio Grande	....	75.20	85.40	36.50	....	....	71.50	35.60	30.10	...	334.30
Denver, South Park and Pacific	....	....	....	...	20.00	9.70	20.00	....	33.01	47 50	130.21
East Line and Red River	....	....	....	....	....	....	18.00	32.00	....	41.88	91.88
Elk and Chautauqua	....	....	....	....	....	....	....	....	....	12.16	12.16
Eureka and Palisade	....	....	....	....	20.00	64.05	....	....	...	....	84.05
Florence, Eldorado and Walnut Valley	....	....	....	....	....	....	29.18	....	....	....	29.18
Fort Scott, South-eastern and Memphis	....	....	....	....	6.50	....	....	6.30	....	2.43	15.23
Fremont, Elkhorn and Missouri Valley	25.34	15.75	....	....	....	....	....	....	....	58.90	99 99
Galveston, Harrisburg and San Antonio	....	....	50.00	50.00	55.00	13.00	47.00	....	....	....	215 00
Galveston, Houston and Henderson (of 1871)	....	48.50	....	....	....	....	....	....	....	....	48.50
Georgetown	....	....	....	....	....	....	....	....	10.00	....	10.00
Golden, Boulder and Caribou	....	....	....	....	....	....	....	....	....	5.60	5.60
Golden and South Platte	....	....	....	....	....	....	....	....	....	2.00	2.00
Gulf, Colorado and Santa Fe	....	....	....	....	....	....	....	45.00	18.60	30.70	91.30
Gulf, Western Texas and Pacific	....	....	....	28.00	....	....	....	....	....	....	28.00
Hastings and Grand Island	....	....	....	....	....	....	....	....	....	25.00	25 00
Henderson and Overton	...	....	....	....	....	....	....	15.00	....	....	15.00
Houston, East and West Texas	....	....	....	....	....	....	....	....	....	71.00	71.00
Houston and Texas Central	50.98	125.58	129.23	44.70	....	....	11.00	....	....	....	361.49
International and Great Northern	....	106.30	196.71	84.30	15.00	....	60.38	....	....	....	462.69
Junction City and Fort Kearney	....	....	....	33.10	....	....	....	....	22 00	15 35	70.45
Kansas Central	....	....	56.00	....	....	....	....	....	28.00	....	84.00
Kansas City, Burlington and Santa Fe	....	....	....	....	....	....	....	....	42.20	....	42.20
Kansas City, Emporia and Southern	....	....	....	....	....	....	....	....	64.00	....	64.00
Kansas City, Fort Scott and Gulf	61.82	....	....	....	....	....	....	....	....	...	61.82
Kansas City, Lawrence and Southern	98.37	44.63	....	....	....	....	....	....	....	....	143.00
Kansas City, Topeka and Western	....	....	....	....	....	66.25	....	....	....	....	66.25
Lake Tahoe (N. G.)	....	....	....	....	....	9.50	....	....	....	....	9.50
Lawrence and South-western	....	....	32.10	....	....	....	....	....	....	....	32.10
Leavenworth Bridge	....	....	1.20	....	....	....	....	....	....	....	1.20
Lincoln and North-western	....	....	....	....	....	....	....	....	....	50.00	50.00
Longview and Sabine Valley	....	....	....	....	....	....	....	....	11.00	1.00	12.00
Los Angeles and Independence	....	....	....	....	....	16.40	....	....	....	....	16.40
Los Angeles and San Diego	....	....	....	6.70	14.00	....	....	7.12	....	....	27.82
Marion and McPherson	....	....	....	....	....	....	....	....	....	48.29	48 29
Marysville and Blue Valley	....	....	....	....	....	....	....	....	....	38.00	38.00
Memphis, Kansas and Colorado	....	....	....	....	....	....	....	....	....	31.04	31.04
Mendocino	....	....	....	....	....	....	3.50	....	....	....	3.50
Missouri, Kansas and Texas Extension	....	....	....	....	....	....	....	4.20	16.19	41.00	61.39
Monterey	....	....	....	....	15.12	....	....	....	....	....	15.12
Nebraska	....	....	....	....	....	....	....	132.00	....	4.40	136.40
Nevada County (N. G.)	....	....	....	....	....	10.64	12.00	....	....	....	22.64
New Mexico and Southern Pacific	....	....	....	....	....	....	....	....	....	118.27	118.27
North Pacific Coast	....	....	....	....	....	51.75	14.50	10.00	....	....	76.25
Northern (of California)	....	....	....	....	....	....	40.81	....	55.00	16.33	112.14
Northern Pacific	114.00	114.23	165.00	136.50	....	....	....	31.00	....	54.00	614.73
Omaha, Niobrara and Black Hills	....	....	....	....	....	....	....	....	....	47.45	47.45
Omaha and Northern Nebraska	26.00	14.00	....	....	....	....	7.00	....	....	16.00	63.00
Omaha and Republican Valley	....	....	....	....	....	....	19.00	42.00	10.00	19.03	90.03
Omaha and South-western	....	....	16.60	30.00	....	....	....	....	....	....	46 60
Oregon and California	60 00	44.00	57.00	16.57	....	....	....	....	....	....	177.57
Oregon Central	....	....	46.70	....	....	....	....	....	....	....	46.70
Pioche and Bulliarville (unincorporated)	....	....	....	....	....	21.00	....	....	....	....	21.00
Pleasant Hill and De Soto	....	....	....	....	....	....	44.90	....	....	....	44.90
Pueblo and Arkansas Valley	....	....	....	10.84	....	54.62	82.39	....	80.87	15.50	244.22
Republican Valley	....	....	....	....	....	....	....	....	40.00	50.80	90.80
Rio Grande	....	3.00	16.00	3.50	....	....	....	....	....	....	22.50
Ruby Hill	....	....	....	....	....	3.00	....	....	....	....	3.00
St. Joseph and Western	112 00	113.70	....	....	....	....	....	....	....	....	225.70
St. Louis, Kansas and Arizona	....	....	....	....	....	....	....	....	....	57.50	57.50
Salina and South-western	....	....	....	....	....	....	....	....	....	35.42	35.42
Salmon Creek	....	....	....	....	....	....	....	8.00	....	....	8.00
San Francisco and North Pacific	23.00	15.00	18.00	....	....	....	16.00	....	....	20.50	92.50
San Luis Obispo and Santa Maria Valley	....	....	....	....	....	3.00	7.75	....	....	....	10.75
San Pablo and Tulare	....	....	....	....	....	....	....	23 71	17.81	....	46.52
San Rafael and San Quentin	3.50	....	....	....	....	....	....	....	....	....	3.50
Santa Cruz	....	....	....	....	....	....	21.16	....	....	....	21.16
Santa Cruz and Felton	....	....	....	....	....	7.10	....	....	....	....	7.10
Seattle and Walla Walla	....	....	....	....	....	....	13.00	7.00	....	....	20.00
Short Creek and Joplin	....	....	....	....	....	....	....	....	....	15.46	15.46
Sioux City and Dakota	....	....	20.86	40.50	....	....	16.50	....	....	35.00	112.86
Soloman	....	....	....	....	....	....	....	....	22.61	34.34	56.95
Sonoma Valley	....	....	....	....	....	....	....	....	....	7.00	7.00
South Pacific Coast	....	....	....	....	....	....	....	....	33.20	6.71	39.91
Southern Kansas and Western	....	....	....	....	....	....	....	....	....	44.90	44 90
Southern Pacific	....	37.09	39.34	95.62	32.20	89.87	196.40	118.60	....	....	609.20
Southern Pacific (of Arizona)	....	....	....	....	....	....	....	0.51	....	182.30	182.81
Stockton and Copperopolis	44.65	....	....	....	....	....	....	....	....	....	44.65
Summit County	....	....	....	8.00	....	....	....	....	....	....	8.00

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Decade.
Texas Central	....	....	....	....	....	....	....	....	....	22.00	22.00
Texas and Pacific	....	23.80	....	253.50	6.10	....	120.40	....	....	....	403.80
Texas and St. Louis	....	....	....	....	....	....	....	22.00	. ..	....	22.00
Texas Transportation	....	....	....	....	....	....	8.90	....	....	....	8.90
Texas Western (N. G.)	....	....	....	....	....	....	....	....	41.00	....	41.00
Thnrston County Construction	....	....	....	....	....	. ..	....	....	15.00	....	15 00
Union Pacific	281.50	....	2.87	....	....	....	....	....	....	....	284.37
Utah Central	36.45	....	....	....	....	....	....	....	....	....	36.45
Utah and Northern	....	....	50.51	12.00	17.00	....	....	....	68.55	125.00	273.06
Utah and Pleasant Valley	....	....	....	....	....	....	....	....	....	55.00	55.00
Utah Southern	....	12 65	17.65	17.04	....	26.16	....	....	....	28.64	102.14
Utah Southern Extension	....	....	....	....	....	....	....	....	....	52.00	52.00
Utah Western	....	....	....	....	17.55	6.79	....	12.58	....	....	36.92
Vaca Valley and Clear Lake	....	....	....	....	....	12.00	....	13 00	....	....	25.00
Virginia and Truckee	....	30 50	....	....	....	....	....	....	....	....	30.50
Visalia	....	....	....	....	7.33	....	....	....	....	....	7.33
Walla Walla and Columbia River	....	....	....	....	....	32 00	....	....	....	14.00	46.00
Wasatch and Jordan Valley	....	....	8.00	....	....	....	....	....	....	....	8.00
Waxahachie Tap	....	....	....	....	....	....	....	....	....	12.00	12.00
Western Development	....	....	....	....	....	....	....	0.13	....	....	0.13
Western Oregon	....	....	....	....	....	....	....	....	....	49.76	49.76
Wichita and South-western	....	....	26.62	....	....	....	....	....	....	....	26 62
Willamette Valley	....	....	....	....	....	....	....	....	....	29.00	29.00

CHARACTERISTICS OF THE NEW RAILWAY MILEAGE.

THE amount of construction during the eighth decade not only greatly exceeded that of any preceding decade, but formed nearly half of the railway mileage existing at the end of 1879, the total mileage at that time being 84,964.65, of which 41,454.22 had been constructed during the years extending from 1870 to 1879, inclusive, and 43,510.43 had been completed at the end of 1869.

Powerful influences had greatly increased the average amount of annual additions to mileage, in comparison with previous decades, some of which were the postponement, for about ten years, of various enterprises, caused by the civil war; the adoption of legislative and financial methods which had the effect of facilitating or stimulating new construction; the rapid extension of settlements west of the Mississippi; the eager desire of important lines to extend their systems; the large grants of land made to railway companies by the Federal government and some of the state governments; the active speculative feeling a few years after the close of the war, and especially after it was supposed that large profits had been derived from the construction of the early Pacific railroads.

A notable change had been wrought since the period when protracted struggles were necessary to secure the construction of lines leading through populous portions of the country, and it had become comparatively easy to rapidly extend roads through uninhabited regions. Many circumstances contributed to the establishment of the new order of things. The general abandonment of the practice of calling upon stockholders to contribute a large portion of the cost of new lines was one of the most important. Roads were no longer built with money furnished by their nominal owners, but chiefly with the proceeds of bonds, or in cases where large advances were made by wealthy projectors they expected to be speedily reimbursed by the sales of bonds and stocks which were freely issued to represent the value of the new railways. The system of creating construction companies which undertook the entire work of completing a line, receiving as its compensation chiefly new railway stocks and bonds, which it marketed, also became more and more extensively adopted. Aside from these devices, wealthy bankers or men whose influence could direct large amounts of capital into any promising channel, manifested a deeper interest in railway projects, and exhibited a greater eagerness to encourage, assist, or control them than had previously been common. The land grants, and the fact that the first of the important land-grant roads, the Illinois Central, had finally become a highly successful enterprise; and the large profits popularly ascribed to the controlling spirits of the early Pacific roads, did much to promote rapid construction by generating a belief in important financial circles that one of the surest methods of securing a rapid increase of wealth was to build new railways, especially if a guarantee against such reverses as had frequently occurred were furnished by valuable grants of land. These hopeful theories carried some rich bankers and many individuals to such lengths that they suffered great losses in enterprises which had been expected to yield large profits, and in connection with other events such reverses superinduced some of the most disastrous developments of the decade, and notably the panic of 1873, precipitated by the difficulties in which Jay Cooke & Co. had become involved by efforts to construct the Northern Pacific.

VARIATIONS IN AMOUNT OF CONSTRUCTION IN DIFFERENT YEARS OF THE DECADE.

It was largely on account of the effect produced by this panic, and the transitions from overweening confidence in all classes of railway projects to distrust of the most promising enterprises, that a remarkable variation in the amount of new construction in different years of the eighth decade occurred. It may be set down as a fundamental truth that the magnitude of the annual new additions to mileage since 1870 have depended much more upon the relative readiness with which the money necessary for construction could be secured than upon any other single influence or circumstance. There is always an abundance of projects, and men ready and anxious to advance them, and the period when they are materialized depends chiefly upon the state of the money market. Eagerness to invest in stocks or bonds has an effect in increasing mileage analogous to that produced by the genial summer suns on vegetation, while panics arising from distrust in old or new railways act like the frost and snows of winter in arresting new developments. The extreme figures in the eighth decade were 7,439.04 miles constructed in 1872 and 1,606.48 in 1875, the amount of new mileage in the latter year being only a little more than one-fifth of the amount of the mileage reported in the former. The average annual amount of new construction was 4,145.42. In each half of the years of the decade this amount was considerably exceeded, viz., 1870, 1871, 1872, 1873, and 1879, while in each of the other half the average figures were not reached; viz., 1874, 1875, 1876, 1877, and 1878. In the increase from 5,657.90 miles in 1870 to 7,439.04 in 1873 can be traced the increasing confidence of investors in railway securities. In the subsequent decline the fruits of the panic of 1873 are observable, and the extent to which distrust was intensified is reflected in the new mileage of succeeding years, including 2,583.79 in 1874, 1,606.48 in 1875, 2,575.38 in 1876, 2,279.68 in 1877, and 2,428.15 in 1878. The first signs of a substantial revival of confidence are furnished by the new mileage of 1879, amounting to 5,006.47.

Aside from the panic of 1873, several other influences greatly retarded the revival that finally occurred in the closing year of the decade, one of which was the granger legislation of the North-western states; another, the railway riots of 1877, and another, the desperate efforts of sundry towns, cities, and counties to repudiate obligations they had incurred for the purpose of promoting new construction.

THE SECTIONAL DISTRIBUTION

of the new mileage of the eighth decade was as follows: Group I, 1,829.91; group II, 11,492.01; group III, 4,196.17; group IV, 13,331.01; group V, 524.27; group VI, 13,473.72.

The new construction in group I, composed of the New England states, and in group III, composed of the states south of Maryland and east of the Mississippi, except Louisiana, had been slightly exceeded in previous decades, 1,889.10 miles having been built in group I during the fifth decade, and 5,424.26 miles in group III during the sixth decade. In all other groups the amount of construction represented a considerable increase, in comparison with any previous decade, and these gains were particularly noticeable in groups IV and VI.

In group II, composed of New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, and District of Columbia, the additions to mileage during the eighth decade were 11,492.01, making the total amount 28,042.09, a considerably larger mileage than that existing in any other group, and the excess in cost of roads and amount of business transacted was much greater than the excess in mileage. The largest amount of new construction in group II in any previous decade had been 8,479.57 during the sixth decade.

In group IV larger additions were made to new construction than in any other group, and the amount, 13,331.01, greatly exceeded the new construction of any preceding decade, the largest figures that had previously been attained being 4,607.70 in the sixth decade. This group is composed of the states of Illinois, Iowa, Wisconsin, Missouri, and Minnesota, and as the legislatures of several of these commonwealths were particularly active in adopting various forms of granger legislation during the eighth decade, it is probable that these proceedings had considerable influence in causing the notable changes in the amount of new construction in each year of the decade in this group. The extreme points were 2,937.64 miles in 1871, before the effect of the antagonistic legislation was felt, and 255.55 in 1875, about which time a disposition to modify specially obnoxious statutes was becoming prevalent. The new mileage of each year was as follows: 1870, 1,915.93; 1871, 2,937.64; 1872, 2,434.27; 1873, 1,555.73; 1874, 756.60; 1875, 255.55; 1876, 541.01; 1877, 539.65; 1878, 854.06; 1879, 1,540.57.

In group VI, composed of Dakota, New Mexico, Wyoming, Montana, Idaho, Utah, Arizona, and Washington territories, and Nebraska, Kansas, Texas, Colorado, California, Nevada, and Oregon, the gain in quantity of new mileage, over any preceding decade, was much greater than in any other group. The region embraced within group VI not only contains an exceptionally large amount of territory, but many districts which have only been opened up for occupation and development at a comparatively recent period. Up to 1859 only 114.68 miles of railway had been built in this group; from 1860 to 1869 the amount of construction was 3,278.19; and from 1870 to 1879 10,080.85 miles.

SALIENT FEATURES OF THE NEW CONSTRUCTION.

While a considerable portion of the new construction of the eighth decade was intended to furnish comparatively short local lines, much of it represented extensions of important sytems, or initial work on new lines of considerable magnitude.

One of the peculiarities of the decade was the amount of interest excited, especially at a period when it had become exceedingly difficult to obtain the means necessary to construct standard-gauge railways, in favor of narrow-gauge lines. The theory was extensively promulgated that in many regions in which standard-gauge lines could not be made paying enterprises, narrow-gauge roads could be rendered profitable; and it was claimed that the difference in the cost of the construction and operation of the two classes of roads was sufficient to make this important distinction in financial results. In 1880 there were 5,190.50 miles of railway built by 144 companies, with a gauge of three feet, and 77 miles additional, with a gauge approximating three feet, built by four other companies. A considerable portion of this mileage has since been widened to the prevailing standard, as it was generally found in practice that the losses and inconveniences arising from lack of ordinary facilities for exchanging traffic with connecting lines more than counterbalanced the gains anticipated from diminutions in cost of construction and operating expenses.

In group I, composed of the New England states, a large proportion of the new mileage represented short extensions or branches or local roads. The only companies reporting more than one hundred miles are those identified with the Portland and Ogdensburg.

Most of the new mileage constructed in group II also consisted of short local roads or extensions. There were, however, a considerable number of additions of a more significant character, viz.: Allegheny Valley, 190.90 miles in length, extending in a northern and north-eastern direction from Pittsburgh, as a branch of the Pennsylvania system; and various lines which have been operated as adjuncts or allies of that system, including the Ashtabula and Pittsburgh, 62.60; Baltimore and Potomac, 91.43; Bedford and Bridgeport, 49.20; Frederick and Pennsylvania Line, 28; Grand Rapids and Indiana, 293.30; South-west Pennsylvania, 44.86; Sunbury, Hazleton and Wilkes-Barre, 43.44; Sunbury and Lewistown, 43.33; Tyrone and Clearfield, 12.58, and a number of other lines.

Each of the east and west trunk lines made direct or indirect new extensions of their systems, which have exercised an influence upon some of the competitive struggles of the eighth and ninth decades. The extensions of the Baltimore and Ohio are partly represented by 262.60 miles of the Baltimore and Ohio and Chicago, completed in 1874, and 89.10 miles of the Pittsburgh and Connellsville, completed in 1871. Operations of the Grand Trunk are partly represented by 237.72 miles of new mileage, constructed during the eighth decade by the Chicago and Grand Trunk.

The new mileage of the decade in group II, representing distinct lines of considerable length, included the following: Buffalo, New York and Philadelphia, 103.86; Chicago and West Michigan, 245.60; Cincinnati, Wabash and Michigan, 110.70; Cleveland, Tuscarawas Valley and Wheeling, 100.54; Columbus and Toledo, 117.77; Dayton and South-eastern, 101.50; Detroit and Bay City, 146.05; Detroit, Lansing and Northern, 171.58; Flint and Pere Marquette, 191.72; Geneva, Ithaca and Sayre, 113.03; Indianapolis, Decatur and Springfield, 100; Jackson, Lansing and Saginaw, 122.53; Lake Erie and Western, 295; Michigan Air Line, 114.72; New York and Canada, 107.12; New York, Ontario and Western, 244.60; Ohio and Mississippi, 278.17; Rochester and State Line, 107.69; Rome, Watertown and Ogdensburg, 192.45; Scioto Valley, 97.20; Southern Central, 115.90; Springfield Southern, 113.45; Toledo, Delphos and Burlington, 155.53.

The important new mileage in group III, including nearly all the Southern states, includes the following: Alabama Great Southern, 165; Atlanta and Charlotte Air Line, 269.63; Brunswick and Albany, 171; Chesapeake and Ohio, 200.88; Chicago, St. Louis and New Orleans, 124.62; Cincinnati Southern, 331.46; additions to Louisville and Nashville, 119; Memphis, Paducah and Northern, 111.37; Paducah and Elizabethtown, 185.70; Port Royal and Augusta, 112; South and North Alabama, 188.88; Washington City, Virginia Midland and Great Southern, 121.80.

A notable feature of the new construction in group IV is the extent to which large additions were made to the mileage of the systems radiating from Chicago. The lines reporting more than one hundred miles include the following; Burlington, Cedar Rapids and Northern, 401.80; Burlington and Southwestern, 142.30; Cairo and St. Louis, 146.50; Cairo and Vincennes, 157.30; Central Iowa, 147.14; Champaign, Havana and Western, 131; Chicago and Alton, 109.64; Chicago, Burlington and Quincy, 120.38; Chicago, Clinton, Dubuque and Minnesota, 208.10; Chicago, Milwaukee and St. Paul, 1,072.33; Chicago and

North-western, 325; Chicago, Rock Island and Pacific, 497.60; Chicago, St. Paul, Minneapolis and Omaha, 201.40; Chicago and Springfield, 111.47; Danville and South-western, 113.10; Green Bay and Minnesota, 218.80; Illinois Midland, 144.90; Iowa Falls and Sioux City, 134.80; Kansas City, St. Louis and Chicago, 162.62; Louisiana and Missouri River, 100.80; Milwaukee, Lake Shore and Western, 190.10; Milwaukee and Northern, 119.70; Minneapolis and St. Louis, 134.16; Missouri, Iowa and Nebraska, 118; Missouri, Kansas and Texas, 786; Peoria, Decatur and Evansville, 100.60; St. Louis, Iron Mountain and Southern, 474.75; St. Louis, Rock Island and Chicago, 287.53; St. Louis and San Francisco, 272.22; St. Louis and South-eastern, 208; St. Paul, Minneapolis and Manitoba, 486.55; St. Paul and Sioux City, 311.18; Southern Minnesota Railway extension, 137; Wabash, St. Louis and Pacific, 434.67; Winona and St. Peter, 222; Wisconsin Central, 324.54; Wisconsin Valley, 108.

In group V the only line reporting more than one hundred miles of new construction is the Little Rock and Fort Smith, 165.10.

In group VI the additions of considerable length included the following: Atchison, Colorado and Pacific, 192; Atchison and Nebraska, 146.60; Atchison, Topeka and Santa Fe, 444.27; Burlington and Missouri River (in Nebraska), 190.50; California Pacific, 113.51; Central Pacific, 280.59; Colorado Central, 168.71; Denver and Rio Grande, 334.30; Denver, South Park and Pacific, 130.21; Galveston, Harrisburg and San Antonio, 215; Houston and Texas Central, 361.49; International and Great Northern, 462.69; Kansas City, Lawrence and Southern, 143; Nebraska, 136.40; New Mexico and Southern Pacific, 118.27; Northern (of California), 112.14; Northern Pacific, 614.73; Oregon and California, 177.57; Pueblo and Arkansas Valley, 244.22; St. Joseph and Western, 225.70; Sioux City and Dakota, 112.86; Southern Pacific, 609.20; Southern Pacific (of Arizona), 182.81; Texas and Pacific, 403.80; Union Pacific, 284.37; Utah and Northern, 273.06; Utah Southern, 102.14.

THE ADDITIONS TO MILEAGE FROM DECEMBER 31, 1879, TO JUNE 30, 1880,

amounted to 2,836.77. It was so distributed in the various groups that the mileage in each on June 30th, 1880, was as follows: Group I, 5,948.30; group II, 28,401.62; group III, 14,315.96; group IV, 22,962.73; group V, 950.38; group VI, 15,222.43; total, 87,801.42.

The relation between the population, area, and value of products to the mile of completed road, in the various groups, on June 30th, 1880, was as follows:—

AVERAGE POPULATION, AREA, AND VALUE OF PRODUCTS TO EACH MILE OF COMPLETED ROAD.

	Total population.	Area square miles.	Population.	Value of products.
The United States	50,155,783	33.8	571	$88,347
Group I	4,010,529	10.4	674	204,673
Group II	18,569,353	8.7	654	131,499
Group III	11,569,173	30.5	833	54,083
Group IV	8,967,136	13.7	391	62,428
Group V	1,742,471	103.7	1,834	123,868
Group VI	4,943,121	114.5	325	31,491

The number of miles of completed railway lying within the boundaries of each state and territory on June 30th, 1880, was as follows:—

Maine	999.35
New Hampshire	1,013.11
Vermont	874.39
Massachusetts	1,868.58
Rhode Island	209.98
Connecticut	922.68
Total of group I	5,888.09
New York	5,874.98
Pennsylvania	5,944.77
Ohio	5,415.33
Michigan	3,712.51
Indiana	4,320 61
Maryland	930.64
Delaware	278.59
New Jersey	1,648.92
District of Columbia	28.38
Total of group II	28,154.73
Virginia	1,697.06
West Virginia	691.56
Kentucky	1,559.56
Tennessee	1,816.17
Mississippi	1,118.99
Alabama	1,780.22
Georgia	2,432.87
Florida	528.60
North Carolina	1,440.39
South Carolina	1,392.91
Total of group III	14,458.33
Illinois	7,562.39
Iowa	4,992.64
Wisconsin	2,959.84
Missouri	3,708.52
Minnesota	2,989.59
Total of group IV	22,212.98
Louisiana	521.90
Arkansas	821.78
Indian Territory	277.43
Total of group V	1,621.11
Nebraska	1,823 11
Kansas	3,384.74
Texas	2,696.64
Colorado	1,385.16
California	2,176.85
Nevada	711.82
Oregon	347.33
Dakota	698.60
New Mexico	298.57
Wyoming	506.94
Montana	18.32
Idaho	205.83
Utah	706.34
Arizona	293.93
Washington	212.00
Total of group VI	15,466.18

FINANCIAL METHODS.

An outline sketch of some of the leading financial devices for procuring the means necessary to advance construction during the eighth decade, and early portions of the ninth decade, is furnished in the following extract from comments in the money article of the Financial Chronicle, of November 4th, 1882:—

"The old, old method of building a railroad was for the subscribers to take either bonds or stocks and pay for them a full price—say 90 to 100—and then the outstanding liabilities represented pretty nearly the capital invested, and the bonds and stocks became valuable according to the capacity of the road to earn interest or dividends. But this method is so old now that it savors of the middle ages, and little has been done on this basis since the war.

Then came the plan by which the projectors issued and sold enough bonds per mile to build the road, and issued a like amount of stock, distributing the latter among themselves. This was the general plan in vogue prior to the panic of 1873, but so heavily were the roads loaded down with interest charges on their bonds, sold at prices which made them pay about 8 per cent. per annum, that few companies were able to survive when the hard times came. Our readers may recall those ghastly list of 'railroads in default' which filled columns in the newspapers.

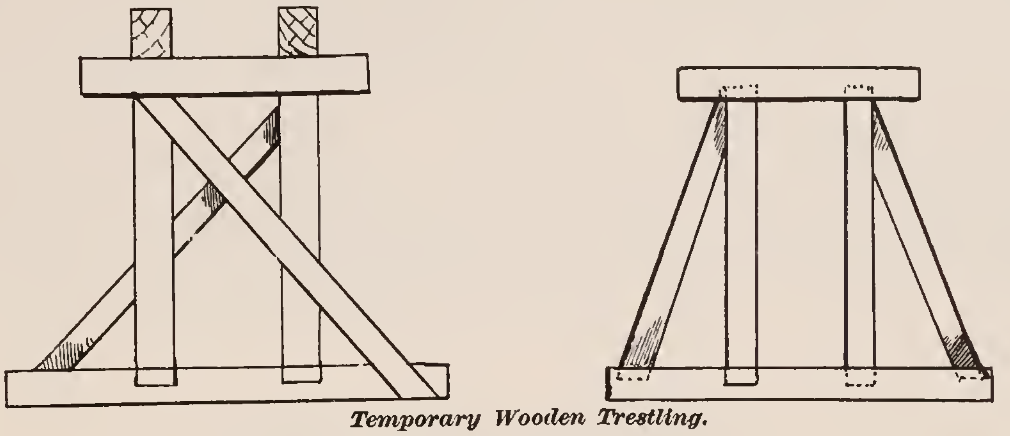
Before 1873 the 'construction company' had been little used, and the famous Credit Mobilier of the Union Pacific, which was the first of those companies to become prominent in the United States, subsequently fell into bad odor. But the construction company has of late years been revived, and very much used as a side corporation, first for the building of the road, and secondly for the distribution of the stock and bonds for the benefit of its subscribers; and whether or not it did the first part well, it has succeeded admirably in the second.

The distribution of stock and income bonds (sometimes in very large amounts) to the subscribers for first mortgage bonds in 'blocks' has been the popular method of late years, and as between this and the 1870–72 plan of keeping all the stock for the projectors, we cannot see why the latter is not the best.

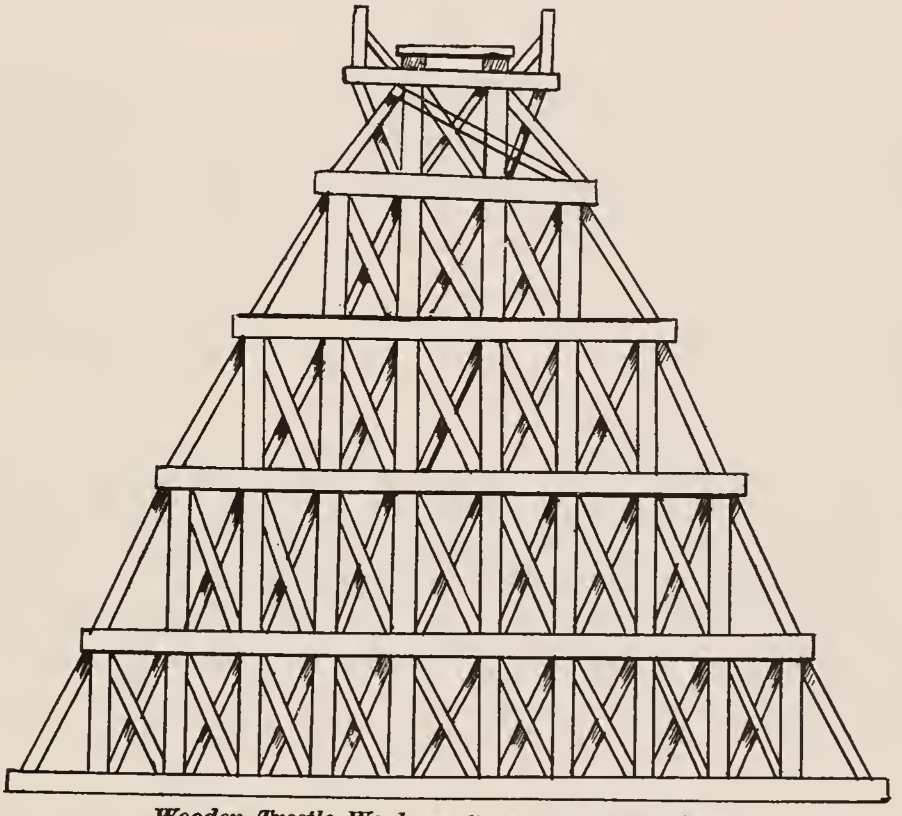
One of the natural consequences of the issue of these large blocks of bonds and stock to subscribers is sometimes seen in the decline of the bonds to very low prices before the railroads are completed. The subscribers, wishing to realize on something, and not finding a ready market for the stock, are apt to sell their bonds at any price they may bring."

EVIL EFFECTS OF FREE RAILROAD SYSTEMS.

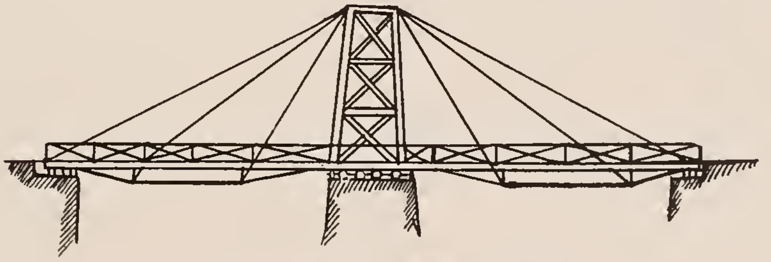
Some of the worst evils arising from the prevailing methods are those connected with an abuse of the privileges easily obtained under free railroad laws. So long as it is in the power of any small body of individuals to obtain charters conferring the privilege of using any desired real estate, under prescribed conditions, for railway purposes, without searching inquiry into the necessity and usefulness of the line proposed, or the financial ability and integrity of the parties who propose to construct it, it is to be expected that grievous wrongs will be inflicted. Schemes will be devised of the class commonly known as blackmail projects, which are intended to benefit the promoters by extortion. They hope to sell their charters, and rights acquired under them, to companies which would probably be injured by damaging rivalry, either while the project is in an incipient stage or after the line is completed. The popular belief that such enterprises will increase accommodations and reduce rates often proves erroneous. The actual cost of transporting any given amount of traffic is increased instead of being diminished by an unnecessary duplication of the lines capable of transacting such business.



Temporary Wooden Trestling.



Wooden Trestle Work on Genessee High Bridge.



Drawbridge of the Sixth Decade.

It is never economical to build two railways to do the work that could be as thoroughly performed by one. Although rates may be reduced, or accommodations increased for a time, on account of the rivalry engendered by competition, it usually happens that either both companies become so seriously crippled that neither can fully provide first-class accommodations, or that a combination of interests is finally effected which aims at securing a return for all the capital invested, so that the public is, as far as possible, finally made to pay for the unnecessary outlays which were unwisely authorized.

Serious wrongs against individuals are also inflicted when real estate is appropriated in defiance of the will of its owners, for railway lines which cannot be promptly finished, or which are in reality unnecessary. Part of the incidental compensation which every land owner should receive is the opportunity of using the line which passes through his property after it is in a completed state, and in the cases where enterprises are so ill-timed or injudicious that such completion is indefinitely postponed after the country is disfigured by deep cuts and high embankments, injuries are inflicted against which the present system does not afford sufficient protection. The justification for a grant of the right of eminent domain to a company hinges on the conviction that the end proposed is an overriding public necessity and that it will be achieved. Free railroad laws, as they are commonly administered, do not furnish sufficient safeguards in reference to either of these points. An increasing disposition is manifested in a few states, and notably in Massachusetts and New York, to increase the restrictions imposed on applicants for railway charters, and to extend the list and scope of the inquiries made into the standing and ability of the organizations which propose to construct new railway lines.

LAND-GRANT RAILWAYS.

RAILWAY MISFORTUNES.

WHILE the early portion of the seventh decade had been the most fortunate period ever known, in a financial sense, for a number of the northern railways, a considerable portion of the eighth decade was a peculiarly disastrous era. They encountered popular antagonism which crystalized into hostile legislation; a shock was given to public confidence in matters relating to their management which, in combination with other adverse influences, led to numerous bankruptcies and receiverships; fierce rivalries found expression in protracted and damaging rate wars; the charges for many classes of railway services fell to unprecedentedly low figures; and a long train of disasters finally culminated in the destructive riots of 1877.

It would be impossible to fully describe all the calamities that occurred. Titanic industrial and monetary forces were engaged in conflicts scarcely less stupendous, in their way, than the clash of armed hosts during the previous decade. Exactly what they meant, how they came about, how far they extended, and how a better state of things was restored, can scarcely be fully comprehended. Many of the proceedings were of a peculiarly American type, and some were an outgrowth of a combination of influences predominating a few years after the close of the war.

Underlying everything else was an irredeemable paper currency, which made the question how soon specie payments should be restored a leading issue for years,—one large body of men, and especially owners of national bonds, striving to hasten such a restoration, and another large body, especially those who were deeply in debt represented by obligations contracted when gold commanded a high premium, endeavoring to retard it, while many active business men believed that their fortunes depended upon the decision reached on this momentous issue. Enormous public, private, and corporate debts had been suddenly created, the burden of which might be borne with comparative ease if the country was flooded with greenbacks, while pecuniary ruin was inevitable in many quarters if the touchstone of gold was too quickly applied. Great transitions had occurred in the prospects of many agricultural districts and manufacturing enterprises, and in connection with numerous avocations producers had become more numerous than consumers. Bright expectations had been disappointed; it was found that many things which had glittered were not gold; a scape goat was in demand; and there was a strong disposition to press the railway system into that undesirable service, which was strengthened by the fact that some of the proceedings connected with its development or management had at sundry times and places furnished legitimate cause of complaint.

The three most important of the events of the early portion of the eighth decade, in exceptional bearing on railway affairs, were

THE RAPID CONSTRUCTION OF LAND-GRANT RAILWAYS,

Granger legislation, and the Jay Cooke panic. It is not improbable that there was a considerable amount of logical connection between these events, but just how far the business of constructing land-grant roads was pushed so rapidly as to inflict temporary injuries on irate farmers, thus inciting Granger legislation, and how far Granger legislation led to a loss of confidence in north-western railway enterprises, which precipitated the Jay Cooke panic, cannot be stated with precision. There is an influence affecting such matters which rarely receives the consideration it merits. It is the effect of unduly increasing the productive power of any great interest at a time when means for disposing of the additional surplus have not been devised, and it is possible that the available agricultural area of the west and north-west had been expanded with so much more rapidity than corresponding markets for surplus products had been created that the most powerful cause of the distress and agitation of the period might be traced to this single source. It certainly was one of the factors of the unfortunate situation, acting in conjunction with the strain produced by the effort to resume specie payments.

The practice of using donations or grants of land, to be earned on condition that a railway should be constructed on a particular route as a basis of credit for such construction, had been well established during the sixth decade, and some of the operations of this description, after encountering a certain amount of financial difficulty, had been attended with remarkable success. It was claimed that through a land grant the entire cost of construction might be defrayed, the proceeds of the lands sold eventually paying the principal of bonds, and the stockholders finally owning an unincumbered property for which they had paid nothing. The civil war temporarily interrupted activity in this direction, but it was no sooner ended than operations were resumed with redoubled activity. This country, unlike all others, has so large a body of men trained to the business of building railways, and more or less familiar with all the legal, engineering, mechanical, and financial tasks involved in this pursuit, that such labors may be regarded as one of the greatest of the established American industries, liable, it is true, to notable fluctuations, but still being pursued, with varying degrees of activity, at nearly all times, by a considerable number of trained contractors, engineers, projectors, financiers, manufacturers of rolling stock and railway supplies, laborers, and other parties. Many representatives of these classes, whose energies had been largely diverted to warlike channels during the first half of the seventh decade, eagerly embraced opportunities for returning to their favorite pursuits after the war was over, and the Pacific and land-grant railways, together with a variety of new southern and south-western and other schemes, afforded extrordinary facilities for gratifying their predilections. According to the stock exchange standard, railways generally had become valuable properties. Leading land-grant roads had been financially successful, and there seemed to be no good reason why the methods their managers had pursued could not be successfully applied to any remarkably fertile region; and whether railways proved to be permanently paying enterprises or not, methods had been devised in connection with the construction of the Pacific and other roads which rendered it reasonably certain that the creation of important new lines would yield a handsome profit to the controlling spirits of such undertakings. The press, the public, politicians, state legislatures, and Congress, instead of endeavoring to interpose obstacles to the rapid development of the schemes of the period, generally went to the opposite extreme, and in many quarters their promotion was habitually advocated as one of the highest of patriotic duties. A national movement of this description is apt to expand into gigantic proportions, especially while it appears to furnish opportunities for profit to many classes, including tens of thousands of settlers, who flock to the new regions, where they can obtain farms by a real or pretended compliance with the provisions of the homestead act; to hosts of adventurers, who aim at becoming the founders or leading inhabitants of new towns and cities that spring up with magical rapidity, and to politicians, state legislators, and congressmen, who receive tangible representations of a share of prospective profits, as well as to railway projectors and constructors, and their indispensable allies and assistants.

It is, therefore, not surprising that several hundred millions of acres of land were granted by Congress to aid railway construction, and that of this amount a considerable quantity of land was sold, while other large quantities remain unsold, and the title to enormous areas remains in the Government, subject to actual or threatened revocation. In addition to lands in the territories granted directly by Congress there was a considerable quantity of land granted by Congress to the states, which was subsequently granted by those states to railway companies, and some of the states, especially Texas, held large bodies of land in their own right which were granted to railway companies. .The magnitude of land-grant railway legislation which had been effective to the extent of securing an actual transfer of title to railway companies, and the amount of sales of land, in 1880, is stated in the census report on railways for that year. This table shows that there was then a wide discrepancy between the quantities of land theoretically or conditionally granted to companies, and the amounts for which they had actually received a title. For instance, the grant to the Northern Pacific was, in round figures, for more than 50,000,000 of acres, while the amount reported in 1880 is set down at 7,743,870.03, acres, and although the main line has been substantially completed since it has continued to be a debateable question in Congress up to 1887 whether the title of the company to the chief body of the lands originally granted shall be forfeited, and sundry bills have been introduced which aimed at forfeiting this title on the ground that the road was not finished within the time originally prescribed. Several grants to other companies have been finally forfeited for various reasons, including the refusal, in some instances, of companies to accept them on the conditions prescribed, and the failure, in other instances, to make any show of vigorous activity whatever, in the way of promoting construction, within a reasonable period. The actual amount of sales of land, derived from state or national land grants, up to 1880, as stated in the census report of that year, was as follows:—

Corporation.	Amount of sales.	
	U. S. government grants.	State grants.
European and North American	$......	$63,328 61
Flint and Pere Marquette	3,132,991 43	......
Grand Rapids and Indiana	3,144,832 68	......
Mobile and Girard	18,270 90	......
Mobile and Ohio	476,611 58	......
Vicksburg and Meridian	85,898 00	......
Chicago, Burlington and Quincy	3,430,572 05	......
Chicago and North-western	......	283,166 42
" " "	......	150,901 49
" " "	......	3,600 69
Chicago, Rock Island and Pacific	2,738,802 93	......
Chicago, St. Paul, Minneapolis & Omaha	......	412,746 48
" " " "	......	362,628 90
Des Moines and Fort Dodge	50,602 00	......

Corporation.	Amount of sales	
	U. S. government grants.	State grants.
Hannibal and St. Joseph	$......	$5,100,873 13
Illinois Central	......	23,703,035 61
Iowa Falls and Sioux City	......	1,991,012 42
Missouri, Kansas and Texas	1,952,126 15	312,661 84
St. Louis, Iron Mountain and Southern	1,042,591 14	......
St. Paul, Minneapolis and Manitoba	1,209,928 99	......
St. Paul and Sioux City	......	2,070,928 74
Stillwater and St. Paul	59,204 89	......
Western (of Minnesota)	......	65,463 27
Winona and St. Peter	174,587 51	......
Wisconsin Central	203,489 76	......
Wisconsin Valley	......	175,826 18
Little Rock and Fort Smith	1,043,885 86	......
Memphis and Little Rock	156,179 63	......
Vicksburg, Shreveport and Pacific	70,620 29	......
Atchison, Topeka and Santa Fe	......	7,342,912 71
Burlington and Missouri River (in Neb.)	8,148,446 81	......
Central Branch Union Pacific	800,000 00	......
Central and Montgomery	......	17,280 00
Central Pacific	4,285,410 33	......
Corpus Christi, San Diego & Rio Grande	......	42,292 90
East Line and Red River	......	82,024 04
Henderson and Overton	......	20,736 00
Houston and Texas Central	......	54,720 00
Northern Pacific	10,481,489 17	......
Omaha and South-western	......	27,898 81
Oregon and California	216,142 04	......
Southern Pacific	1,017,255 89	......
Texas and Pacific	......	181,677 64
Union Pacific	6,923,706 09	......
Waxahachie Tap	......	7,944 58

The only companies reporting more than one million acres of lands granted by the United States government, and unsold in 1880, were the following: Mobile and Ohio, 1,038,998.84 acres; St. Louis, Iron Mountain and Southern, 1,132,625.86; St. Paul and Duluth, 1,276,138.26;-St. Paul, Minneapolis and Manitoba, 2,769,584.36; Winona and St. Peter, 1,315,571.50; Central Pacific, 11,045,705.46; Northern Pacific, 5,347,859.40; Oregon and California, 2,465,142.93; Southern Pacific, 11,684,536.60; Union Pacific, 10,431,561.38. The only companies which reported more than one million acres of grants received from states, unsold in 1880, were the Atchison, Topeka and Santa Fe, 1,826,835.31; Galveston and Camargo International, 3,604,480; Houston and Texas Central, 5,203,520; Texas and Pacific, 4,755,862; Texas Trunk, 3,584,000, and several other Texas railway companies, whose grants had not been located or patented.

The following statements of the amount of railway construction which had been secured by land grants in each state or territory and of the amount of land granted and certified, up to 1880, were published in that year:—

Mileage Constructed Through Land-Grant Aid.

States and territories.	Miles.
Alabama	822
Arkansas	575
California	1,228.89
Colorado	298
Dakota	196
Florida	247
Illinois	705.72
Indian Territory	155
Iowa	1,580
Kansas	1,654
Louisiana	152
Michigan	1,005
Minnesota	1,745
Mississippi	406
Missouri	703
Nebraska	832
Nevada	460
Oregon	227
Texas (where there are no United States lands)	342.87
Utah	255
Washington	106
Wisconsin	533
Wyoming	400
Total	14,628.48

Number of Acres Granted and Certified.

States	Acres granted.	Acres certified.
Illinois	2,595,053.00	2,595,053.00
Mississippi	2,062,240.00	935,158.11
Alabama	2,579,120.00	2,829,545.86
Florida	2,360,114.00	1,760,468.39
Louisiana	1,578,720.00	1,072,405.45
Arkansas	4,878,149.14	2,376,139.63
Missouri	2,985,160.21	1,828,005.02
Iowa	6,795,527.31	3,940,270.75
Michigan	4,712,480.29	3,228,987 09
Wisconsin	4,808,436.07	2,672,803.56
Minnesota	9,992,041.95	6,925,351.19
Kansas	9,370,000.00	3,851,536.28
	55 717,041.97	34,015,715 33
Corporations: Pacific railroads	159,486,766.00	8,831,687.79
Total	215,203,807.97	42,847,403.12

Number of Acres of Land Granted by Congress for Railroads Each Year.

Year.	No. of acres.	Year.	No. of acres.
1850	3,751,711	1865	128,000
1852	2,280,635	1866	64,902,000
1853	1,856,711	1867	100,000
1856	12,083,295	1869	1,100,000
1857	4,126,638	1870	2,741,600
1862	15,345,166	1871	24,152,515
1863	4,430,000		
1864	50,787,579	Total	187,785,850

It will be seen by the statements of amount of land sales that in a few cases, and notably in that of the Illinois Central, the receipts for land represented large sums; but, generally speaking, revenues from this source did but little to pay either the cost or even the interest on the cost of the land-grant roads. The financial facts of the entire land-grant construction of the country present a notable contrast with some of the theories ventilated on this subject. Speedy success was the exception rather than the rule; disastrous failures were numerous; and the grant of large quantities of land to aid construction had two effects which helped to precipitate a crisis, viz.: First, a wide extension of the practice of attempting to build railways without any substantial basis of cash capital legitimately paid for capital stock in sums approximating to a considerable percentage of its nominal value; and second, an effective encouragement of attempts to construct railways over numerous routes at periods when it was practically impossible to attract a sufficient amount of traffic to earn interest on cost, or even, in some instances, operating expenses. The waste of capital involved in building railways before they were needed, became doubly injurious when the chief effect of efforts to attract population to their lines was to stimulate the overproduction of the surplus breadstuffs and provisions upon which many western and north-western states relied for the payment of pressing obligations. Some of these obligations, in turn, had been contracted for the purpose of aiding railway construction, especially those represented by taxes imposed to meet the interest on bonds issued by towns and counties to promote the construction of new lines, and there were also some individual subscriptions to railway stock by farmers whose ventures in that direction had been decidedly unprofitable.

EFFECT OF LAND-GRANT RAILWAYS IN HASTENING SETTLEMENTS.

The following extract from an address delivered by Mr. Drake, a president of a land-grant road, in 1876, gives some interesting experiences:—

"About six years ago," says Mr. Drake, "I went out with my engineer to locate a road in the southern part of Minnesota, to Sioux City, in the northern part of Iowa. We traveled with our camp equipage, because there were no houses there. We traveled as far as thirty miles at times without seeing the vestige of a human habitation, or a person, over, perhaps, as fine a body of land as there is under the sun. We camped out at night, lived on the provisions we carried with us, and often found ourselves in places where there was not a tree for thirty miles, or a stick or switch large enough to hitch a horse to. A herd of antelopes during the day roamed around us for a distance of forty miles, in sight of which we drove every hour or two. That was in the south-western part of Minnesota. In the north-western part of Iowa, a state with over a million people, I have traveled for thirty miles without seeing a solitary habitation or human face. I am happy to say, or, rather, unhappy to say, that one of those counties has been since organized, and has made a debt of $250,000 for the land-grant roads to pay. . . . We all know that railways, particularly those built during the war, at the expense at which they were constructed, could scarcely be built with any hope of profit through the sparsely settled parts of our country. . . . Take the case that I have cited in Minnesota, of the St. Paul and Pacific road, a road that I was first indirectly connected with. For probably 150 miles upon that road there is now a dense settlement for a prairie or new country, sending off from a single station from one to three hundred thousand bushels of wheat, where four or five years ago there was not a settler, and where, to this day and for all time to come, it would have remained unsettled but for that railway. . . . "Scarcely a road in Minnesota would have been built, but for land grants. We had a prairie soil, stretching off for more than one hundred miles, and along the road which I represent there is not a cord of wood to-day, except what has been planted by the railway since it was located. We passed through township after township, and mile after mile, and not a single acre of land, that had been surveyed for years—the finest land under the sun—not one single acre had been taken by anybody. We commenced building the road, and before it was graded almost every acre, except the railway grant, was taken up on the theory of actual settlement, but which theory was very much abused, of course. The homestead, and particularly the pre-emption laws, the soldiers' claim law, and the tree claim law were all very much abused.

A little incident occurred to me which I may relate. I happened to be riding over our road to Omaha with a late Secretary of the Interior, when he turned to me and said: 'Mr. Drake, why is it that these lands are not settled up? As far as the eye can reach there isn't a single man to be seen here.' Said I: 'Mr. Secretary, the evidence exists in your department, under oath, that every even section of this land is taken up, and has an actual settler upon it.' To his question what I meant, I replied: 'These are pre-emptions, taken up by actual settlers, and sworn to, and you have granted patents in your office to them.'"

RAILWAY PANIC OF SEPTEMBER, 1873.

As there had been panics in 1854 and 1857, which were attributed mainly to an undue amount of railway construction, but which, in the judgment of many persons, were caused largely by the imperfect nature of the banking system existing in those years, and especially by the effects of an actual or threatened suspension of specie payments on all business affairs, so there was in September, 1873, a panic which injuriously affected many persons and interests that was regarded chiefly as an outgrowth of excessive or premature railway construction; and it occurred at a period when specie payments had been suspended for about a dozen years, and there was no expectation of speedy resumption, and when the national bank system was in successful operation. This is frequently called

THE JAY COOKE PANIC,

because it commenced on the day the failure of the firm of which he was the head was announced, which was September 18th, 1873. This failure was of much more consequence than the downfall of ordinary banking houses, because Jay Cooke had been the leading negotiator of the enormous loans made by the United States government during and shortly after the war, and because he had subsequently assumed the task of disposing of the bonds necessary to procure the means for constructing the Northern Pacific Railroad—this sum being estimated, in round numbers, at not much less than one hundred millions of dollars—and it was on account of the failure of this firm to sell such bonds as rapidly as means were required for construction at the rate it had been progressing, and its advance of firm funds and deposits to meet such expenditures, that the failure occurred. On the line of the Northern Pacific there had been constructed in 1870 114 miles, in 1871 114.23 miles, in 1872 165 miles, and in 1873 136.50 miles—a total of 529.73 miles. No new construction whatever is reported in the three succeeding years of 1874, 1875, and 1876. In 1877 the new mileage reported is 31, and in 1879 54 miles, making the total amount for the decade 614.73 miles. The rapidity of the progress made to the end of 1873, and the extent to which further proceedings were delayed, are indicated by these figures. But they furnish an inadequate idea of the magnitude of the undertaking or the extent of the financial and industrial derangements caused by the panic.

PREMONITORY SYMPTOMS.

Before September 18th, 1873, there had been a notable decline in the price of many stocks, as compared with quotations in the early part of that year. Tight-money spasms had occurred, and the rates for carrying stocks about the 1st of April had been quoted as high as from ⅝ to 1 per cent. per diem. This influence, a growing feeling of distrust, and a superabundance of railway securities, had caused in a great number of stocks about as large a decline from January 1st to September 18th as that which followed the panic. There was also a financial failure announced on September 17th, which did much to precipitate the crisis, as on that day the paper of the New York and Oswego Midland Railroad was protested. The following description of the effect of this disaster was published by the New York Tribune in its money article relating to the events of September 17th: "There was a dreadful sweeping away of stock margins to-day, the depreciation covering the entire list, and showing a decline from the closing quotations of last night to the lowest points reached to-day of from ½ to 7 per cent., and averaging about 2½ per cent. . . . There will no doubt be a general overhauling of brokers' ledgers to-night, and the mails will go out freighted with letters calling for more margins. Of course, many may be unable or unwilling to respond, in which case their stocks will be forced upon the market, and sold for what they will fetch, the tendency of which will be to still further depress prices. . . . The banks are holding their money fast for their own protection, and next for that of legitimate trade, that the whole business of the country may not be demoralized for the sake of a few wildcat railroads and wildcat bankers, who lend their name or their cash by the million to companies who have no immediate resources. It will require the utmost caution on the part of our leading capitalists and heavy security owners to avert a panic, and perhaps a crash like that of 1857. The minds of capitalists and operators are surcharged with distrust, and the air of Wall street with rumors, started generally in the bear interest, of failures, defalcations, and of disasters dire."

This being the reported condition of affairs on the morning of September 18th, the effect of the announcement of the failure of Jay Cooke & Co. may be more easily imagined than described, especially as it was followed, after a very brief interval, by the announcement that banks and firms in various cities, with which Jay Cooke was closely identified, had also failed, and that a similar disaster had overtaken several prominent New York capitalists, who were actively engaged with two other railway construction schemes. On the 19th of September a series of other important failures were announced, and by the 20th the panic on the New York Stock Exchange reached such alarming proportions that it was considered necessary to close the Exchange, and suspend all formal dealings, a suspension continued until the end of the month.

FLUCTUATIONS IN RAILWAY STOCKS.

At the Philadelphia Stock Exchange, on September 18th, the opening prices for Pennsylvania Railroad stock was $53, and the closing price $49½, and on the following day, September 19th, the closing price was $44½. The opening price for Philadelphia and Reading, on September 18th, was $54, it fell during the day to $51, and closed on the following day at $49½. During the remainder of the year there were unusually violent fluctuations in the quotations for Pennsylvania, which fell at times below $41, but generally reacted, to some extent, quickly. The last reported sale of the year 1873 was at $47⅝.

In the New York Stock Exchange the prices of stocks during September, 1873, include the following fluctuations:—

	High.	Low.
Chicago, Burlington and Quincy	98½	90
Chicago and North-western	64¾	40
Chicago and Rock Island	108⅞	86
Columbus, Chicago and Indiana Central	31¼	19
Delaware, Lackawanna and Western	100½	86
Erie	59⅞	50¾
Harlem	130¼	90
Hannibal and St. Joseph	37¼	19
Lake Shore	93	73
Michigan Central	90¾	80
Milwaukee and St. Paul	51	30
New Jersey Central	102	91¼
New York Central	105¼	89
Ohio and Mississippi	39¼	26½
Union Pacific	27½	16
Toledo, Wabash and Western	70¼	38½

OF THE GENERAL EFFECTS OF THE PANIC,

the United States Railway and Mining Register, of September 27th, 1873, says: "The panic of last week has resulted in a standstill of financial houses, giving a rude check to the eastward movement of the grain crop and the foreign steamship freight business outward, and threatening manufacturers who deal in wares used for transportation. The Paterson locomotive shops, for example, have reduced their force by a thousand men. . . . The suspension of four or five heavy banking houses has caused a virtual suspension of the national banks, who see fit to mark all large checks good, and only pay out small amounts of currency to enable artisans, &c., to pay their employés." In its issue of October 4th, 1873, it said: "The panic has passed, but its effects persist. Currency has been drawn from every bank and savings fund, to be distributed through the country. Certified checks take the place of greenbacks for the time being; and are being considered a par currency; bank notes are at a premium of 2 to 3 per cent., and have been sold as high as 5. Gold is flowing in from England, on account of the paralysis of exchange paper; yet it was quoted at 115 a week ago, and had only fallen to 110½ on Thursday. This represents about 108 as to certified checks. The scarcity of currency seriously affects manufactures. Some of the railways in progress have been stopped. The Bergen Hill work of the Delaware, Lackawanna and Western Railroad, for instance, is suspended, throwing 400 men out of employment. The Danforth Locomotive Works, at Paterson, New Jersey, work two gangs on alternate days. The Morris and Essex Railroad discharged 150 men on Tuesday. Atkins' Fischbach rail mill at Pottsville suspended work September 30th, setting 200 men idle. The European bourses are beginning to sympathize with ours. On Thursday trade and speculation in Berlin were at a standstill and a crisis was expected. The Bank of England has advanced its rate of discount."

In its issue of October 18th, 1873, it says: "It was to be expected that the shock to speculation, the failure of bankers, and the disappearance of currency would embarrass manufacturers, but few anticipated the re-exportation of millions of dollars' worth of silks and wines and articles of luxury back to Europe, the general reduction of orders for work, the running of many factories and shops on half time, the dismissal of railway operatives and employés, and the cutting down of wages from 10 to 20 per cent. The working population had no inkling of the approach of such events, and are alarmed and indignant at probable consequences. . . . Rolling-mill wages have been reduced from 10 to 15 per cent. at several of the largest works, and many mills expect to suspend work altogether for lack of orders. Over two hundred men employed at car works in Jersey City have quitted work, it is stated, because the company has paid them no wages for two months. It was reported on Thursday that the Louisville shops were dismissing many of their workmen, and that the Nashville operatives say they have not been paid off for two months. The rolling mills have resumed operations after a week's suspension. The Ohio Falls Car Company has suspended work until all accounts are settled with their railroad debtors. The banks have resumed currency payments."

In addition to the indications given above of the effects of the panic, one of the most important was the sudden lowering of the standard of railway credit at home and abroad. It became almost impossible for several years to borrow considerable amounts of money to be used in new railway construction. The credit of established companies, which were engaged in extensive undertakings, was seriously impaired. The securities which had been issued for work actually done on new lines fell to a merely nominal sum, and in some instances they could scarcely be disposed of at any price. The amount of new railway construction in 1874, and during several subsequent years, fell far below that of 1873, and except in connection with enterprises so far advanced that comparatively small sums were necessary to insure completion, short lines, and narrow-gauge projects, which suddenly gained favor on account of their alleged cheapness, the work of building new lines was suspended or abandoned for several years.

NATURE OF THE NORTHERN PACIFIC PROJECT.

While it is probable that many causes contributed to the panic of 1873, there can be no doubt that the most prominent was the large amount of new railway construction progressing during several years previous, especially that portion of it which was in districts where traffic was insufficient to pay interest on the cost of completed lines or divisions. The Northern Pacific was the most prominent and important representative of the American land-grant roads and land-grant methods of construction, and the disaster which overwhelmed Mr. Cooke, and greatly reduced the nominal value of the bonds he had sold to the extent of about a score of millions of dollars, illustrates more fully than any event which has ever occurred in this country the perils that attend extensive land-grant projects. What they were, in this instance, was clearly stated in a report made at Berlin, in November, 1871, after an elaborate investigation of the line of the Northern Pacific and all matters pertaining to it, by Herr Haas, a German engineer, who had been engaged by German capitalists to report on the question whether it would be advisable to make investments in the Northern Pacific bonds. The report states that the company proposed to issue bonds to the amount of $100,000,000, which sum was intended to provide means for constructing about two thousand miles of railway. Its estimated cost, including necessary appurtenances, and interest on capital during construction, exclusive of earnings, was $85,277,000. The amount of the land grant to be earned was about 50,000,000 acres. All this land and the completed road were mortgaged, and held in trust as security for the payment of interest and the redemption of the bonds, and two of the questions answered were as follows: "Does the finished line offer the necessary guarantee that the net profit of its income will yield the sums required for the half-yearly payment of the stipulated rate (7.30 per cent.) of interest on the bonds? Will the sums realized from the sale of lands suffice to redeem the bonds within thirty years?" These important questions were both answered in the negative, and detailed reasons were given for the conclusions, which display much good judgment and correct reasoning. The point to which most importance was attached was that after the completion of the line there would be a period during which the company would not be able to earn the interest on the cost of its line by profits from operation, and chiefly on this account European capitalists were advised to decline participation in the enterprise.

A similar danger attended various other land-grant projects, and experience has demonstrated that the losses incurred by operating a road that does not earn interest on its cost during a series of years goes far to counterbalance advantages derived from land grants.

GRANGER LEGISLATION—RAILWAY COMMISSIONS.

OUT of the rapid development of land-grant roads and various other influences grew granger legislation. It was the commencement of a new form of legal antagonism to railway property, or at least an assertion of the right of state legislatures or commissions to definitely prescribe the charges that should be imposed for railway services, after the roads had been constructed with the understanding on the part of those who furnished the means for such construction, that the right of making rates was vested in the railway managers.

This movement was chiefly the outgrowth of an irate and discontented spirit among the farmers of the states of Illinois, Wisconsin, Iowa, and Minnesota, acting in unison as members of an organization called the National Grange, which was first started in 1867, suddenly became popular in 1872, and had in 1874 a reported membership of 1,600,000, with subgranges in all the agricultural states, which were specially numerous in the states named above.

The central northern portion of the Mississippi valley was the theatre of the most active demonstrations, and this was the region to which a large population had been attracted, during a comparatively short period, by efforts of land-grant railways to dispose of their lands, as well as by the general course of emigration previous to the war and shortly after its close. Transportation charges possessed for its farmers vital significance, on account of the long distances over which their surplus products had to be moved to reach an available market, and the paucity, at that time, of the manufacturing development of the districts they inhabited.

Attention has already been directed to the wonderful things done by railways previous to 1860 in the way of increasing the value of western farm lands and the prosperity of farmers, but these benefits had been enjoyed chiefly by residents of regions east of the Mississippi, and especially those who lived in states located, like Ohio, near the western slope of the Appalachian chain. It was obviously more difficult to confer corresponding benefits on farmers in states west of the Mississippi like Iowa, Minnesota, Missouri, and Kansas; but due allowance was not made, by disappointed farmers, for this difference, or for the extent to which the advantages of the cheap and fertile land they possessed were offset by remoteness from the seaboard.

During the war and for some time after its close the demand for breadstuffs and provisions was so great, and prices were generally maintained at such a high level, that industrious western and north-western farmers had little cause for complaint in regard to their pecuniary condition and prospects. Discontent became nearly universal under the general pressure caused by the additional competition of new farmers, the sudden return of a large body of men from warlike scenes to peaceful agricultural avocations, the construction of many new railways through fertile districts which furnished additional farms, and the gradual transition from greenback to gold valuations of all descriptions of property while the burden of debts remain unreduced.

THE FAVORITE PANACEA FOR ALL GRIEVANCES WAS A REDUCTION IN THE CHARGES FOR TRANSPORTATION,

and it was part of the granger agitation to aim at securing such reductions; first, by the passage of state laws fixing railway rates, either through commissions or legislative enactments, at figures satisfactory to farming interests; and second, by obtaining congressional aid in cheapening through movements, either by the improvement of waterways, regulation of charges of trunk lines, or the construction of a cheap national freight railway. All these methods found earnest advocates.

So far as national relief is concerned the trunk lines have for years been carrying to the seaboard, from western centres, large quantities of western and north-western produce at much lower rates than the grangers hoped to secure over land routes in 1873, and something similar has happened with a large proportion of their local rates since traffic has increased and numerous mechanical improvements have been made which helped to cheapen the actual cost of transportation. But the effort to hasten such a cheapening of cost by force of legislation, against vigorous protests of the companies affected, and without regard for the rights of investors, inflicted a severe shock on railway credit.

THE NATURE OF THE DEMANDS MADE BY THE GRANGERS,

and their methods of enforcing them, are indicated by the following resolutions, which form part of the platforms of various conventions held in North-western states during 1873:—

"That we receive with satisfaction the decision of the Supreme Court of this state (Minnesota) in the case of Blake against the Winona and St. Peter Railroad Company, in which the court holds, in effect, that the railroads are simply improved highways, public roads, and that as such the right to prescribe a rate of tolls and charges is an attribute of the sovereignty of the people of which no legislature can divest them.

"That we will not aid in elevating any man to any important public position whatever who will either deny or object to the exercise by the legislature of the power to reverse or annul at any time any chartered privilege or so-called vested right, or any privilege claimed to be involved in any charter to any corporation, railroad or otherwise, which experience has shown is or may be exercised by such corporation or by other similar corporations to the detriment of the public welfare, and that we will demand from every candidate for a high executive, legislative, or judicial position to whom we accord our support, that he shall pledge himself to recognize the maintenance of this right by the Government as a sacred duty, essential for the preservation of the liberties of the people and the stability and prosperity of the commonwealth.

"That we demand a state law that will pay out of the public funds the costs and charges of all suits brought by individuals to enforce the laws of the state against railroad companies.

"That all corporations are subject to legislative control; that those created by Congress should be restricted and controlled by Congress, and that those under state laws should be subject to the control respectively of the states creating them; that such legislative control should be an express abrogation of the theory of the inalienable nature of chartered rights, and that it should be at all times so used as to prevent moneyed corporations from becoming engines of oppression.

"Whereas, The legislature of Illinois, at its late session, passed a law defining and providing for the punishment of extortion by any railroad companies within this state, fixing the penalties at from $1,000 to $5,000 for the first conviction of any railroad company; from $5,000 to $10,000 for the second; from $10,000 to $20,000 for the third, and at $25,000 for every subsequent conviction, which sums, when collected, shall be paid into the treasury of the county in which conviction shall be had, for the use of said county; and whereas, upon due information furnished, it is made the duty of the railroad commissioners to cause suits to be commenced and prosecuted for said penalties, at the expense of the state; and whereas, the question as to extortion in any such prosecution is one of fact to be decided by a judge; therefore,

"Resolved, That the people of this state (Illinois) have a remedy for the extortions to which they are subjected by the railroads within their reach, and we recommend to the various farmers' associations herein to furnish such information to the railroad commissioners, without delay, as will warrant the prosecution of suits for the collection of penalties to the full extent to which the railroad companies may be liable."

DOMINATION OF GRANGER INFLUENCES.

A full record of the laws for regulating railway charges actually passed, and the legal battles which followed their passage, would require much more space than is available; but some of the more notable features of the granger agitation are too important to render an omission of all mention of them justifiable. One of the peculiarities was the overwhelming pressure they were enabled to bring upon all branches of local government. A remarkable instance of this was furnished by the defeat at the polls of an upright state judge, when he was a candidate for re-election, on the avowed ground that he had made a decision which helped to furnish to railway companies a temporary barrier against aggressive legislation. Aspirants for legislative, congressional, judicial, and executive positions considered this as a warning that, for the time being, unyielding acquiescence in granger demands was the price of the popularity necessary to enable them to gain or retain power, and they acted in accordance with this opinion, thus virtually placing the whole powers of the Government at the service of the leaders of the agitation, except so far as restraining influences were provided either by state or Federal constitutional provisions, or judicial interpretations of chartered rights of railway companies, or reactions of granger sentiment, especially those based on the discovery that by acting too harshly the construction of new lines, which many persons desired, would be prevented.

Unlike many of the older states, in which a considerable number of citizens were interested pecuniarily in local lines, as stockholders and bondholders, the granger states had few of such investors; and so far as ventures had been made by their farmers, or residents of rural districts, in railway investments, they had usually been so unfortunate that the results had generally converted the parties concerned into specially earnest advocates of legislation hostile to the railways. This last-named phase of the subject probably had more influence in generating an ultra hostile sentiment than is commonly supposed. How it grew up can be best illustrated by the following

STORY OF A GRANGER VICTIM OF RAILWAY ENTERPRISE,

which was told to a correspondent of the New York Tribune, about the time the agitation was at fever heat, by a Wisconsin farmer. Speaking of the land-grant roads of that region he said:—

"Do you know how these roads have, most of them, been built? In the first place, they got land grants that in some counties are worth almost as much as the roads cost. Then they sent agents to the counties through which the road was to be built, who induced them to vote bonds to the companies and take stock; in some instances they provided them a first mortgage on the road when it should be completed. Then they got bonds from cities, and, in some cases, even from townships. Of course the interest on these all has to be raised by taxing us farmers. But that is not all. Their agents went through the country, and wherever they found a farmer who had a few hundred dollars laid by, they persuaded him to buy the stock of the road, and pay cash for it. Their argument was a very plausible one; they told us that we were paying from twenty-five to fifty cents a bushel to get our wheat hauled to Milwaukee, and that when the road was completed they would carry it for from five to ten cents. The difference would be added to the value of every bushel of wheat that we raised. Then the road would belong to the farmers, and, of course, we were all going to get rich. I took $2,000 of stock in this (Chicago and North-western) road and paid cash for it. But a great many of the farmers had no money to spare, and they were induced to give the railroads mortgages on their farms. They were assured that before the time came to pay their mortgages the road would be built and the value of their crops would be enough increased to enable them to pay up, and at any rate their farms would be enough enhanced in value to more than make up for the mortgage. In some cases the farmers took stock for these mortgages, and in some the promise of a first mortgage on the road as soon as it should be built.

Well, now, how do you suppose they treated us? They did'nt give the farmers the mortgage on the road that they promised, but when they gave them anything it was a second mortgage on long time. The first was a short one given to capitalists. That was, of course, foreclosed, the road sold out, and the value of the stock and bonds held by counties, towns, and individual farmers destroyed. I could find you stacks of certificates and bonds for which our farmers paid cash or mortgaged their places, and which are now not worth as much as the blank paper on which they are printed. Thousands of farmers were absolutely ruined."

There may be exaggeration in this statement but something like the events described probably occurred in connection with a considerable number of the land-grant or other roads of the granger states, and it is obvious that such occurrences would have the effect of stimulating adverse legislation, without regard to its justice or the rights of non-resident owners or creditors of railway property.

SPECIFIC GRANGER GRIEVANCES AND REMEDIES.

At the root of all that is peculiar in granger legislation, as contradistinguished from other attempts to regulate railway charges by law, lies the fact that nearly all the original charters of the north-western lines omitted such references to maximum charges as were common elsewhere. Instead of saying that the railway managers should have the power to establish freight and passenger tariffs *provided* they did not exceed certain fixed sums per ton per mile or per passenger per mile, no check whatever of this kind was imposed. This form of legislation proved to be a delusion and a snare. Instead of permanently giving to the railways the unlimited powers which were apparently conferred, and for a time exercised, its practical effect was to transfer the period of a legislative exercise of a right of regulating charges or fixing maximum rates to a specially inauspicious era. This view seems to be substantially justified by the fact that the first decision of the Supreme Court of the United States in cases involving the validity of granger railway legislation says: "It was within the power of the company to call upon the legislature to fix permanently this limit [of maximum rates] and make it a part of the charter, and if it was refused, to abstain from building the road, and establishing the contemplated business. If that had been done the charter might have presented a contract against future legislative interference. But it was not, and the company invested its capital, relying upon the good faith of the people and the wisdom and impartiality of legislators for protection against this form of legislative regulation."

It is obvious that maximum rates prescribed by a legislature at a time when the railways to which they are applicable have not been constructed, and when the communities concerned earnestly desire to promote their construction, and to encourage distant capitalists to provide the means for meeting the large necessary outlays, are likely to be considerably higher than the maximum rates fixed by a legislature or commission after railways have been in operation for some years, and after a feeling of hostility to their management has been engendered; and, to a considerable extent, the north-western lines were made to feel the magnitude of this difference by the marked contrast between the detailed schedules imposed by granger commissions and the character of the limitations that were fixed in the charters of some of the railways of older states. A good illustration of these differences, as well as of the extreme lengths to which some of the granger legislation extended, in the way of endeavoring to compel railways to render services for inadequate compensation, is furnished by the following compendium of portions of a joint memorial presented by the Chicago and North-western, and the Chicago, Milwaukee and St. Paul Railways, in 1875, to the Wisconsin legislature, as an argument in favor of a repeal of the Potter law, passed at a previous session:—

"On lumber, per car load, *the Potter law allows $25 for 200 miles*, while the Boston and Albany charges $40; the Vermont Central, $46; Erie, $37; Great Western (of Canada), Michigan Central, Illinois Central, each $38; Lake Shore, $35; Indianapolis, Cincinnati and Lafayette, $56; the Hannibal and St. Joseph, $65 per car load. On grain, per 100 pounds, the rates are for 225 miles: Vermont Central, 31 cents; Boston and Albany, 30 cents; Erie, 25 cents; Pennsylvania, 36 cents; Pittsburgh and Fort Wayne, 32 cents; St. Louis and Kansas City, 34 cents, and Chicago, Burlington and Quincy, 36 cents. *The Potter law allows 22½ cents for the service.* On agricultural implements, wagons, &c., the differences are most remarkable, in many cases exceeding 100 per cent. Comparisons are also made with foreign railway tariffs. The leading railroads in Great Britain are selected. On flour per barrel, per 100 miles, the English roads charge: Midland, 36 cents; North-western, 96 cents; London, Brighton and South Coast, 30 cents, and Glasgow and South-western, 40 cents. *The Potter law allows 28 cents.* Upon agricultural implements the English rates are more than double the Potter rates. These differences are still more remarkable, in view of the relative cost of operating the roads. Last year the cost per mile run on the Milwaukee and St. Paul Railway was $1.39, while on the Cleveland and Pittsburgh it was 54 cents; on the Philadelphia and Reading, 61 cents; on the Pennsylvania, 94 cents. Upon 28 Massachusetts roads it averaged $1.28, and upon all the roads in Great Britain in 1872 it averaged 66 cents per train mile. This is largely owing to the increased cost of fuel, Wisconsin companies having to pay for inferior coal three times the price per ton paid by Pennsylvania and Ohio companies."

"UNJUST DISCRIMINATION"—AND THE LONG AND SHORT HAUL.

Various other states, in attempting to make detailed regulations of railway rates, committed errors similar to those depicted above, as part of the requirements of the Potter law, passed in Wisconsin, but a disposition to correct such errors was frequently manifested by the repeal or material modification of specially unjust laws or regulations of commissioners; and in Illinois, where these agitations first commenced, with the incorporation of a radical clause in the new constitution of that state, the leading popular complaint was not that the general range of railway charges was too high, but that the charges for movements to or from competing points was considerably lower than movements of equal length to or from non-competing points, and that one of the outgrowths of this condition of affairs was that the charges were frequently higher for movements of a given kind, of a given quantity, on a given day, over a given line, over a relatively short distance, than for a freight movement exactly similar over a longer distance, if the latter happened to be to or between competing points, while the former was not. It was on this issue that the first legal battle of importance growing out of granger legislation was fought.

The decision was favorable to the railway company concerned, mainly on the ground that the law passed relating to this subject was unconstitutional on account of its assumption that a higher charge for a short haul than a relatively long one was necessarily an unjust discrimination. It was well understood by all concerned that the real cause of the distinction was that a concession favorable to the long-haul shipper was necessary to meet the competition of rival lines.

The issue involved was whether railway companies, after being obliged to confront the losses arising from excessive competition, which arose principally from the custom of granting charters to all persons who asked for them, were guilty of "unjust discrimination" when they charged more for a short haul between non-competing points than a longer haul to a competing point, or between competing points.

The intense interest excited at various times and places in controversies on this issue, and the enduring nature of the agitations which have been maintained in reference to it, not only in the granger states but in various other commonwealths, and finally in the nation at large, indicates that it is one of the fundamental matters relating to transportation about which two well-defined sets of opinions have become firmly rooted. Nothing seems more natural and proper to many men engaged in moving persons and things than to impose a larger charge for a short movement than a longer one, provided there are legitimate reasons for such a distinction, such as those arising from the necessity of meeting competition at the more distant point which does not exist at the point to which the short haul extends. On the other hand, a large portion of the general public which has manifested an interest in railway regulations, grave and able legislators, and shippers living at non-competing points consider that the practice referred to is under all circumstances inexcusable, and that it necessarily represents a form of "unjust discrimination" that should be strictly forbidden by law.

A RAILROAD PRESIDENT'S EXPLANATION OF THE CAUSES OF THE GRANGER AGITATION.

In September, 1873, John Newell, then president of the Illinois Central Railroad Company, was asked by the United States Senate committee on transportation routes to the seaboard, what were the causes of the popular complaints against railways in Illinois, and in reply made the following statement:—

"The great cause of complaint here in Illinois was first created by the low price of corn last year, and that was simply brought around by causes that I suppose were not under the control of anybody here; it was brought around simply by the immense overproduction, which put the value of the surplus simply at the price at which the European supply could be delivered in Great Britain; or, in other words, the Liverpool price controlled the price here, and the cost of getting it to the seaboard, difficulty with the freight rates across the ocean,—which were large and have been increasing since—left a margin here of 18 to 20 cents a bushel at the stations around Illinois last fall, which was an exceedingly low price. That is, as I view it, the fundamental cause of complaint. But, beyond that, the farmers and shippers all about the state have discovered that the local charges of all our railways here where competition did not exist were a good deal higher than they were where there was competition. We (railway managers) have all discovered that when we cannot get the price we want for carrying on business, to pay a fair dividend on the values of the property, we take what we can get, and the consequence was that we were all hauling property from competing sections at a great deal less rates than from intermediate stations. That, of course, attracted attention here, and, perhaps, was the immediate cause of the great complaint about discrimination and extortion.

But, as I view it, the other cause is really the fundamental cause of the whole complaint. The prices for the transportation for one hundred and fifty or one hundred miles out of Chicago, on grain, are perhaps three or four cents per ton per mile, while rates from here to the seaboard, and from the same stations in the interior of Illinois to the seaboard by direct route, were about a cent and an eighth to a cent and a half per ton per mile. People seeing this difference say 'you are extortionate,' where we charge from three to four cents. On the other hand, the prices that we get—taking Mattoon, one hundred and seventy-three miles south of Chicago—it has a road direct to New York, all rail, it has five cents a hundred above the rates existing from Chicago at the same time; sometimes ten cents, and from five to ten cents is the difference. We have hauled a good deal of grain from Mattoon [to Chicago] for ten cents a hundred pounds. We charge from Kankakee, fifty-six miles south of Chicago, I think, eleven cents, if my memory is correct; and you see eleven cents for fifty-six miles, and ten cents for one hundred and seventy-three miles, creates at once this feeling of extortion and unjust discrimination. Now these two facts are the real cause of the complaint in this state against the railways."

At this point the committee asked, "What are the causes of that discrimination?" The response was as follows:—

"The principle is simply this: We say the prices we are charging for local business are fair prices, and on them only we can maintain a fair income upon the value of the roads; for when we come to a station where the business either goes away from it or is taken at a small advance over the cost, we say we will keep that business as a small help added to the general result, and enable us to make much better dividends. That is to say, if we continued our high rate we would lose entirely a traffic which pays us a small profit, and we judge it better to retain that small profit, as it helps, if you please, to keep down the prices at an intermediate station. . . . We say this: The volume of business upon the majority of the lines of Illinois and the states west of Illinois is so small that they cannot afford to take a price which, upon a line worked up to its capacity, will yield a fair profit. There are none of the lines of Illinois, even single tracks, worked up to their capacity. . . . The average earnings in this state are a little over $8,000 a mile for all the roads, and the earnings in this state are double, I think, those of either Iowa or Wisconsin. In the state of Minnesota you get only a little over $3,500. I think Iowa is a little over $4,000, and Wisconsin, $4,000."

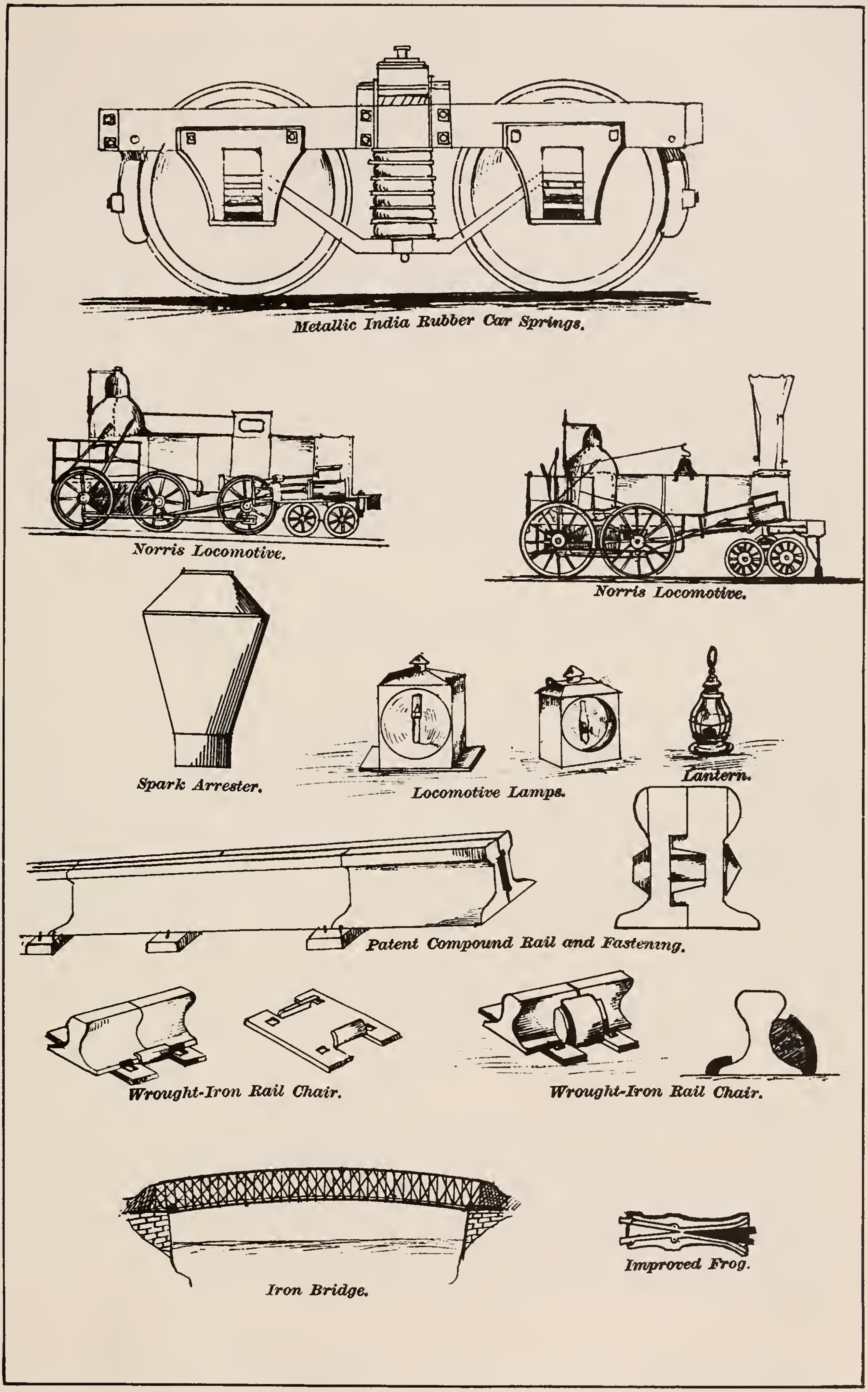
NEW SYSTEMS OF RAILWAY REGULATION.

The incorporation of a radical railway clause in the new Illinois constitution in 1870 seems to have been the signal for the commencement of a new era in the railway legislation or governmental supervision of railways in this country. At all events it was quickly followed by the granger agitation, the incorporation of similar clauses in the constitutions of other states and corresponding legislation, together with the appointment of state railway commissions, which have now become established institutions in a majority of commonwealths, and some of the southern states, as well as western and north-western states, substantially adopted the entire granger system of railway regulation. In 1870, also, the first report of the Massachusetts railway commission was made. That body, unlike the commissions of a number of the north-western and southern states, had very limited powers, its actual duties being rather to examine and report on alleged railway abuses, than to endeavor to prescribe rates or to enforce remedies, yet it has exercised through the series of years it has been in existence, a more decided influence upon the railways subjected to its supervision than commissions entrusted with greater powers. Of the numerous railway commissions created since 1870 it may be said, in general terms, that the scope of their authority has represented almost every conceivable variation between the limited jurisdiction of the Massachusetts commission and the extensive powers conferred upon some of the north-western and southern commissions.

A matter of special importance, in the bearing of these creations of commissions endowed with various powers, on the development of transportation systems, hinges on the fact that the commencement of their operations marks a new era. Before that period the chief concern of all progressive communities was to promote railway construction—to get railways, honestly if they could, but to get railways—while after that period the desire to procure new lines, which had by no means become extinct, was strongly intermingled with a popular determination to impose upon the lines already in existence much more stringent checks of one kind or another than had previously been attempted. The various forms of regulation proposed, most of which were applied to some extent, consisted chiefly of plans which had previously been suggested in England. They included the following:—

1. Equal mileage rates.
2. Rates to be fixed by relation to cost and profit on capital.
3. Immediate reduction of rates.
4. Periodical revision of rates and fares.
5. Absolute limitation of dividends.
6. Division of profits beyond a certain limit between companies and the public.
7. Enforced interchange of traffic, through rates and running powers.
8. Publication of rates.
9. Combinations and consolidations with competing lines to be prohibited.
10. Railway companies to be required to receipt for quantity, and to account for the same at destination.

Attempts to enforce some of these regulations had been made in various states previous to 1870, and some of the methods were so obviously objectionable that they found few advocates at any time in any country, but other methods included in the above list, that were never enforced by law in the United States previous to the eighth decade, have since been stringently applied at various times and places to railway operations, and it seemed to be considered a prominent part of the duty of legislatures and Congress to devise methods for regulating railways and modes of conducting railway operations after 1870, whereas previous to that time the chief concern of the national and state law-makers was to devise measures for facilitating the construction of new lines. It is to be regretted that the amount of wisdom and justice brought to both of these tasks fell considerably below the desirable quantity.



RAILWAY APPLIANCES USED IN 1851

CONGRESSIONAL ACTION—TRANSPORTATION ROUTES TO THE SEABOARD.

However deficient in wisdom and justice the average successful American politician is, when he is acting as a law maker or in an executive capacity, he usually displays astuteness in discerning the bent of popular inclinations. This is the one subject he must understand, under penalty of a loss of place and power. While voting away land grants and Pacific railway subsidies combined, with the enjoyment of popular favor, opportunities for enriching the givers of grants and subsidies, no set of men were louder in their praise of such grants than those who quickly changed front under the pressure of the granger agitation, and other manifestations of popular disapproval, to become zealous advocates of sundry stringent methods of railway regulation.

It has already been stated that the grangers demanded national as well as state action for their relief, and either in response to this demand or for other reasons a committee was appointed by the United States Senate in December, 1872, of which Hon. William Windom, of Minnesota, was chairman, to investigate and report upon the subject of transportation between the interior and the seaboard. It instituted the most elaborate inquiries that had ever been made into all matters affecting through rail and water movements, and in April, 1874, made a lengthy report. The summary of its conclusions includes recommendations that laws should be passed providing for the publication of rates, the prohibition of combinations with competing lines and "stock watering," and the establishment of a national bureau of information charged with the duty of obtaining and publishing annually such facts relating to interstate commerce as would enable Congress to legislate intelligently on the subject. But the committee announced that it was of the opinion that "the problem of cheap transportation" is to be solved through competition, furnished by modes it stated and advocated, "rather than by direct congressional regulation of existing lines."

These modes consisted, first, of "one or more double-track freight railways, honestly and thoroughly constructed, owned or controlled by the Government, and operated at a low rate of speed;" and second, an improvement or extension at the national expense, or by appropriations of Congress, of the following water routes, for the purpose of increasing their efficiency as competitors of railways, viz: 1st. The Mississippi river. 2d. A continuous water line of adequate capacity from the Mississippi river to the city of New York, via the projected Hennepin Canal, the northern lakes, and the New York canals, enlarged and improved at the national expense. 3d. A route through the central tier of states, from the Mississippi river, via the Ohio and Kanawha rivers, to a point in West Virginia, and thence by canal and slackwater, or by a freight railway, to tidewater in Virginia. 4th. A route from the Mississippi river, via the Ohio and Tennessee rivers, to a point in Alabama or Tennessee, and thence by canal or slackwater, or by a freight railway, to the ocean.

These routes were respectively designated as the Mississippi, Northern, Central, and Southern routes.

RIVER AND HARBOR IMPROVEMENTS.

THE recommendations of the Windom committee exercised little or no direct effect in the way of procuring speedy action of Congress upon the subject of new railway regulations, or in stimulating the construction of a new cheap through-freight railway by the United States government, or in procuring appropriations for the construction or improvement of canals. But indirectly the influence of the proceedings of the committee, and of the agitation they typified, may have had some effect in intensifying the vigorous efforts of east and west trunk lines to reduce charges for moving north-western produce to the seaboard to unprecedentedly low figures; and either on account of their recommendations or for other reasons the magnitude of appropriations for river and harbor improvements began to increase with notable rapidity.

Effective harbor improvements are at once very useful and at the same time exceedingly difficult and expensive. Many localities naturally sought the aid of the General Government in constructing such works, and to a limited extent it was granted at a comparatively early period, but the regular annual expenditures for such purposes rarely represented considerable sums before 1870. Appropriations for the improvement of some of the most important lake and oceanic harbors had been made before 1850, however, and in 1828 appropriations were made for the construction of the Delaware Breakwater, which was regarded, during a protracted period, as the leading claimant of works of that class to national support, on account of its utility as a refuge for numerous vessels sailing along a perilous portion of the Atlantic coast. About forty years elapsed before this work was finished in accordance with the original plans, and since that time urgent requirements for its extension or improvement have been developed. The total expenditures upon it from 1829 to June 30th, 1885, were $2,422,195.27.

Meanwhile the transition from small sailing vessels to large steamers had rendered the original approaches to nearly every harbor in the country totally inadequate. They have nearly all been improved by national outlays of varying amounts, some of which represent large sums and notable engineering achievements, and there is a constant demand for additional appropriations to be expended in various classes of harbor improvements from many localities.

The wide scope of such applications is indicated by the fact that the river and harbor bill of 1886, after being subjected to a horizontal reduction of twenty-five per cent., contained appropriations for the improvement of about one hundred and fifty harbors, the amounts to be expended at each point varying from a few thousand dollars to $750,000. Some of these harbors were located on the Altantic coast, some on the Pacific, some on the gulf of Mexico, some on the northern lakes, and some on tidal rivers. In a few instances improvements which are practically equivalent to the construction of large dams or harbors on non-tidal rivers have also been authorized.

The river, creek, bayou, channel, shoal, and bar improvements for which appropriations were made in the same bill were more numerous, amounting to several hundred, and the sums appropriated varied from a few thousand dollars to $1,687,500 for a continuance of the improvement of the Mississippi river from the head of the passes to the mouth of the Ohio river. Some of the appropriations provide for the

REMOVAL OF SNAGS

by snag boats, an operation which has been conducted on an extensive scale on western rivers, and yielded an exceptionally large return in the way of direct benefits to owners of water craft, in proportion to expenditure.

Operations of this kind began on a comparatively small scale some years ago, but during later periods they have been conducted systematically with snag boats specially built for the purpose, under the supervision of the United States government. Snags are felt for and caught with an iron chain hanging in a loop from the bow of a stern-wheel steamer, and raised with a powerful derrick and windlass worked by steam. The trunks are often quite large, reaching in some instances to a length of 60 feet and a diameter of 5 feet. The snag boat H. G. Wright, during eight months work in 1881, destroyed 1,909 snags; cut out of river banks 5,005 trees which would probably have finally caved into the rivers; and removed 15 drift piles. The following is a statement of work done on the Mississippi, Missouri, and Arkansas rivers, from March 28th, 1868, to June 30th, 1881:—

Rivers.	No. of snags pulled.	No. of trees cut.	No. of drift piles removed.
Mississippi	14,582	54,605	107
Missouri	13,309	47,042	335
Arkansas	5,083	8,059	76
Total	32,974	109,706	519

These labors had an important effect in preventing injuries and losses of steamboat property.

Other propositions contemplate the purchase or acquisition of different classes of river or canal improvements originally made by states or incorporated companies, with the understanding that they are hereafter to be maintained at the national expense, and not to be subjected to tolls or other charges.

The amount expended previous to 1886 is shown by the following table of

THE AGGREGATE APPROPRIATIONS FOR THE IMPROVEMENT OF RIVERS AND HARBORS

from the beginning of the Government, March 4th, 1789, to June 30th, 1882, as shown by the report of the Secretary of War, transmitted to Congress by the President of the United States, January 22d, 1884:—

	Amount.
New York	$10,237,611 28
Michigan	7,984,877 25
Wisconsin	4,659,541 74
Delaware	3,327,164 69
Massachusetts	3,119,499 08
Ohio	3,116,147 29
Illinois	2,672,305 00
Texas	2,566,200 00
North Carolina	2,399,058 92
Virginia	1,734,850 00
Maryland	1,731,817 50
California	1,717,000 00
Connecticut	1,585,926 82
West Virgioia	1,531,300 00
Maine	1,475,884 48
Georgia	1,412,596 54
Pennsylvania	1,158,042 23
New Jersey	1,099,063 00
Alabama	1,091,751 82
South Carolina	963,000 00
Indiana	786,203 92
Florida	760,350 09
Rhode Island	733,700 00
Oregon	654,000 00
Vermont	551,980 20
Kentucky	457,000 00
Minnesota	447,500 00
Mississippi	337,900 00
Arkansas	316,500 00
District of Columbia	291,500 00
Louisiana	245,400 00
New Hampshire	202,500 00
Tennessee	85,500 00
Missouri	22,000 00
Idaho Territory	10,000 00
Washington Territory	5,500 00
Iowa	2,500 00
Miscellaneous	39,667,664 77
Surveys	4,985,713 40
Repairs, &c	3,977,157 12
Dredging machines, &c	1,135,257 54
Grand total	$111,299,464 79

After this report was made the law of 1882 appropriated $18,988,875, and the law of 1884 appropriated $13,949,200, giving a grand total of expenditures for this purpose previous to 1886 of $144,237,539.

The appropriations charged directly to the states refer only to the harbors and rivers that are wholly within the several states, and those improvements which are designed to benefit two or more of the states are grouped together under one aggregate, under the head "miscellaneous."

THE SUPERINTENDENCE OF RIVER AND HARBOR IMPROVEMENTS

is intrusted to an engineer bureau belonging to the War Department, of which General John Newton, who had charge of the submarine operations at Hell Gate, was for some years previous to 1886 the official head. This bureau reports upon all proposed river and harbor improvements, and in a general sense directs all works of the kind under consideration undertaken by the Government, including all the harbor works of the sea coast and the great lakes, the improvement of rivers when undertaken in the interests of navigation, and the canals built in connection with the river improvements for overcoming rapids, except the Mississippi river improvements, the supervision of which is intrusted to a commission, but the actual work it approves is also prosecuted under the superintendence of the engineer bureau of the War Department. The controlling spirits of all these labors are military engineers and army officers, usually graduates of West Point, and in 1884 there were in service under the chief of engineers 8 colonels, 14 lieutenant-colonels, 26 majors, 32 captains, 26 first lieutenants, and 4 second lieutenants, an aggregate of 110 army officers, nearly all of whom were engaged in the performance of labors which bore a relation of one kind or another to river and harbor improvements, including the examination of a number of small streams, in accordance with the directions of Congress, for the purpose of ascertaining whether they could be made navigable.

The whole country is divided into districts, which are made larger or smaller, according to the number of works in process of construction within them, each of which has at its head a colonel, lieutenant-colonel, or major, or in a few cases one of the older captains. These officers conduct the works within their districts, consulting but rarely with any other public authority, and receive their orders directly from the chief engineer, in whose bureau there are three higher officers as division chiefs. The younger captains and lieutenants are assistants of the district engineers.

In addition to these military engineers who are permanently in the national service, as part of the army, a considerable number of civil engineers are employed in directing works of various kinds whenever liberal appropriations are made, but they are liable to a sudden dismissal when such financial support is not furnished.

During recent years an animated controversy has sprung up in regard to the intrinsic merits of this system. Antagonism to it emanates from two sources, viz., first, a number of the civil engineers of the country, who allege that they are unfairly treated, and that the Government is frequently deprived of the services of the best available engineers, and second, friends of various river and harbor improvements, who question the wisdom and efficiency of some of the plans adopted for the accomplishment of various purposes. Both classes of complainants contend that training as a military engineer does not furnish the best method of instruction for all the difficult and complicated labors involved in the creation of artificial harbors and the control of majestic rivers.

The specific provisions of all

RIVER AND HARBOR BILLS

habitually receive severe criticisms from members of both branches of Congress, including those who finally vote for them, as well as persistent opponents. The aggregate results of the harbor and tide-water appropriations include an important influence in hastening the commercial development of a number of ports or cities, and in facilitating the substitution of relatively large steamers for comparatively small vessels, on the lakes, the gulf, and the oceans, thus cheapening the transportation movements identified with various classes of internal, coastwise, and foreign commerce. It has frequently been asserted, however, that a considerable proportion of the appropriations have not rendered any substantial service whatever, and that a number of them are made for objects of such doubtful utility that they may more properly be regarded as traps to catch the votes of national legislators, and to enable them to secure the good will of their constituents, than as judicious and necessary outlays for improving rivers or harbors.

The tenor of these criticisms is shown by the following telegraphic abstract of a speech made in Congress, May, 1886, when the river and harbor bill was under consideration, by Mr. Everhart, of Pennsylvania:—

"No place, he said, was so grand, and no spot so insignificant, that it was not included within the provisions of the bill.

It was not restrained by any unpronounceable name, by any obscurity of situation, by any difficulty of access, by any mass of obstruction. The scope and purpose of the bill seemed extraordinary. Every sort of enterprise which was usual in everyday business seemed to be invoked in order to extend the scope of the jurisdiction of the committee on rivers and harbors. Channels all obstructed with mud or rock or rapids were recklessly to be deepened or widened without regard to the ultimate possibilities of commerce. Canals were to be bought or built or seized. Dykes and dams were to be constructed, in order to give relief to sovereign states or riparian owners. Numerous and costly experiments, which had failed in the past, were to be repeated at an extravagant cost on the Father of Waters, with no assurance of beneficial results to navigation. Rivers were to be improved where alone the alligator wallowed and the pelican fed; inlets where King Frost held carnival in palaces of ice, and shores where no keels had moored, and which seemed as remote and fabulous as those of Calypso and Atlantis. There was nothing that seemed to be too incredible to be embraced in the contents of this bill. Such was the measure before the House—this unpretentious roll which seemed to have in it places which no gazetteer had ever mentioned, and nomenclature which no polyglot lexicon could explain, and climatic regions where no signal bureau could correspond. This volume, this book, this simple scroll, though it were not elegant like the volumes that had the imprimatur of Elzever or the binding of Baskerville, though it were not as rare as the Palimpsests of the Vatican, or as interesting as the story of the 'Splendid Shilling' or the 'Adventures of a Guinea,' was yet written with colossal figures which no bank ledger could display. It was teeming with treasures, with lines and letters that glistened with gold."

The Government has made appropriations for so many classes of works that they practically embrace all known methods of improving the navigation of waterways. The only qualification or barrier which has been seriously urged, provided a stream is or can be made navigable, is that it should be capable of being serviceable to commercial operations of national importance, but this restriction is of little consequence, and in a few instances it has been directly disregarded, such as the expenditure of money for improving the navigation of small lakes never used in connection with lengthy freight movements.

NOTABLE HARBOR IMPROVEMENTS.

The most direct and important influence exerted by the national system probably relates to the construction or enlargement of harbors and the removal of approaches to them. Nearly if not all the important lake, gulf, and oceanic harbors have been greatly improved, especially in the matter of removing obstructions, and increasing the available depth of channels, so as to ensure the safe approach and protection of large steamers. Two of the most important of such improvements are those made at the south pass of the Mississippi, by which the depth of water in the approach to New Orleans has been about doubled, and in the bay of New York, by which a large similar addition to the practical value of the channel has been made. Much of the work involved in these undertakings was peculiarly difficult. The outlet of the Mississippi was improved by the successful application of a jetty system that attracted much attention. The improvement of the New York harbor necessitated, among other things, one of the most extensive rock-blasting operations that was ever attempted. Of the approaches to New Orleans, it is said that on one day in 1859, fifty-two vessels were reported to be fast in the mud at the passes, while the jetty improvements enable vessels of larger size to move freely. Another notable and novel achievement was the construction of the Davis Island dam near Pittsburgh, by which a harbor was created for that city, at the head of the Ohio river. Previously, or simultaneously, improvements of various descriptions were progressing in or near the harbors of, or the aquatic approaches to, nearly all the prominent ports of the country, the nature of the operations being varied with their respective requirements. A principal end at all ports on tidal waters was to afford appropriate facilities to vessels of a decidedly larger size than those formerly used.

In view of the peculiar industrial position of this country, viz., that of a nation which very greatly exceeds all others in its quantity of surplus production of raw materials, and comparatively cheap and bulky articles, such as petroleum, cotton, tobacco, breadstuffs, and provisions, and a contemporaneous scarcity of national mercantile vessels engaged in foreign trade, most of the harbor improvements have probably rendered a service which greatly exceeds their cost, inasmuch as they have made American ports much safer and more attractive to foreign steamships of large size, and thus increased the facilities for a cheap outbound foreign movement of the commodities our citizens wished to sell. While this important purpose is served, various domestic ends have been promoted, such as the creation of possibilities for employing larger vessels in coastwise commerce than could formerly be used, and the consequent cheapening of movements between lake, gulf, and oceanic home ports to an extraordinary extent. Generally speaking, the improvements of all tide-water channels have been intended to promote the main purposes briefly described above, and they have resulted in the removal of many serious or dangerous obstructions.

WESTERN RIVER IMPROVEMENTS.

NON-TIDAL river improvements form the most important class of questionable undertakings by the Government. So far as they relate to the removal of snags and bars on rivers of considerable consequence, there is little or no doubt of their utility and propriety. National aid was also granted at a comparatively early period to the construction of a canal round the falls in the Ohio, which, after being originally constructed under the direction of a company, aided by Federal subscriptions to its stock, was purchased outright, and made free of tolls, and although a precedent was thus established of aid to canal schemes, which may have had a tendency to encourage applications for a class of less meritorious objects, the importance which the Ohio then possessed as a leading channel of internal movements justified the outlays made. The debateable river issues that have arisen relate chiefly either to the actual or proposed outlays for a large number of streams of infinitesimal size and capacity, or to the particular plans proposed for improving the Mississippi. They are of gigantic magnitude, and the probable expenditure is roughly estimated by some of the friends of the system adopted at about $50,000,000, and by some of its opponents at about $150,000,000. Aside from differences of opinion in regard to the probable amount of the appropriations that will be required, acrimonious controversies have arisen in relation to the extent to which levee systems should be repaired, as part of the river improvements. Before the civil war the states lying adjacent to the banks of the lower Mississippi undertook the task of maintaining levees or artificial embankments, varying in width from four to thirty feet, for the purpose of protecting adjacent lands from overflow. An immense amount of productive territory was thus made available for profitable agricultural operations. The United States government indirectly furnished a large portion of the means for constructing or improving these levees by conveying the title to the swamp lands reclaimed to the states.

During the war and for some years after its close these states were unable to continue appropriations for the maintenance of levees, and many regions which had once been productive were devastated on account of this neglect. Since the lower Mississippi river improvements undertaken by the United States government have been progressing, at a considerable annual expenditure, the question has been repeatedly raised, in various shapes, whether money should or should not be expended in repairing the levees. It is conceded on nearly all sides that the only legitimate object of the national outlays is to improve the navigation of the river; but on one side it is contended that this end can best be attained by repairing or erecting levees or substitutes for them at numerous points, where they would necessarily afford additional protection to adjacent lands, while on the other side it is contended that the only appropriate field for national effort is in the bed or channel of the river itself, and that much of the work hitherto done upon the levees has had a tendency to diminish rather than to increase the navigability of the river.

As the Mississippi and its tributaries drain a very large proportion of the entire country, and as the outflow of water during high-water periods is enormous, the difference between high- and low-water marks at some points being about fifty feet, and the quantity of water discharged at the outlets being occasionally increased to about ten times its lowest volume, the problems involved in the plans for improving and controlling this great national artery of the continent are of stupendous magnitude and complexity. Indications of the difficult nature of the task assumed by

THE MISSISSIPPI RIVER COMMISSION

are furnished by the following extract from a speech delivered by one of its members, Hon. Robert S. Taylor, at a waterways convention held in New Orleans in 1885:—

"The Mississippi river has three great faults. It tears down its own banks; then with the material taken from them it builds great bars across its own path; then having blocked up its channel with them, it overflows its banks, and spreads over the adjacent country. It is a self-willed and head-strong stream, and must be managed as a woman manages her husband—never offering to contradict him, and letting him think all the time that he is doing as he pleases.

A reach of bad navigation presents ordinarily an abnormal width, numerous dividing channels, and shifting bars. The first step in the improvement of such a reach is to lay out a track for the regulated channel through it—a task requiring the greatest skill and good judgment, as upon its wise execution the success of all subsequent work may depend. The next step is to induce the river to flow in the path thus prepared for it, which is accomplished by the closure of all other channels, and the narrowing of the space on the bar where necessary, by deposits of earth secured by means of permeable dykes, as open as a fence, through which the water flows freely, but which check its velocity below them sufficiently to cause it to make deposits of sediment. These structures are called "contraction works." They are in progress at Plum Point and Lake Providence reaches, and in those places have been entirely successful in execution and result.

I do not believe that any greater obstacles can be found anywhere in the execution of this kind of work than those which have been met and overcome in Bullerton and Stack Island chutes, and on Baleshed and Elmot bars. In their effects they have answered every expectation of their construction. Three years ago an experienced river pilot said to a member of the commission, speaking of the work laid off at lake Providence, 'You've staked her out right where she ought to run; the thing is to make her go there.' Well, 'she' is going there now, and with a channel depth at low water double that which she had before. The like is true at Plum Point. The practicability of narrowing the channel by contraction works, and the certainty of increased depth from the scour thereby induced, have been demonstrated by actual success. And it is a success at which I have never ceased to marvel.

The deposits which fill these chutes and build banks on these bars are mere specks of earth. A teaspoon would hold thousands of them. As the water bearing them slackens its speed after passing the permeable dikes, they quietly drop to the bottom like microscopic flakes of snow. And yet, the space which has been filled with solid earth by this process in the reaches under improvement measures thousands of acres in area, and from a few inches to fifty feet and upward in depth, and well on to 300,000,000 cubic yards in contents. The works by which these deposits have been secured have been costly, more so than like works would be now, and yet I think it safe to say that the cost of the earth filling has been little, if any, above a cent a cubic yard.

If the river would stay in the improved channel prepared for it, the work of improvement would be completed. But this it will not do until some means are employed to check the violent caving of banks in and about the reaches to be improved. Indeed it will require but a moment's attention to perceive that the caving of the banks is the prime cause of all the ills that afflict the river. As it cuts into the earth on one side, and deepens the curve of its channel in that bend, it necessarily alters the direction by which its current swings into the bend next below, and so that bend, in its turn, is cut and carved in a new outline to fit the new curve of the channel. By the same process these changes are transmitted to the second bend below, and so on, from bend to bend, as the undulations travel down the back of a snake. And, indeed, you have but to look at the map before you, and mark the crescent-shaped lakes—fragments of old river bed—that line its course on either side, to see how literally true it is that the Mississippi has writhed like a serpent in its broad, black nest through all the centuries that have measured its life.

As the river washes away its bank on one side it commonly adds to the opposite shore by deposit; so that one bank advances as the other recedes. But where the caving is violent it is impossible for the river to build the convex side up to full bank height as rapidly as it cuts away the concave side; so that the net result of the process is an increase of width. And finally the coarser parts of the earth taken from the caving bank are carried only a short distance, and go to build up the bars below, and as the caving is more active their growth is more rapid.

So that we have three distinct consequences—instability of channel location, increase of channel width, and an acceleration, at least, of bar formation, each directly traceable to the caving of the banks. But these are the very things that impair the channel. If we could be rid of them our task would be done. It is necessary, therefore, to employ some means to fix and hold the banks—not everywhere, but wherever the location and rapidity of the caving are such as to endanger the other works of improvement about or below them. The devices used for this purpose—mainly brush mattresses, I cannot take time to describe. They constitute a distinct class of work known as 'revetment' or 'bank protection.'

The third kind of work employed is levees. The place which these structures hold in the general ground work of improvement has been defined repeatedly in the reports of the commission and elsewhere. In brief it is this: The ordinary flood is the period of the river's greatest energy; confined within the banks of uniform grade that energy is made useful in scouring and deepening the channel; allowed to escape through varying and uneven depressions, not only is its energy lost, but there is caused an irregularity of flow in the channel which tends to produce increased deposit of sediment.

These are the measures of improvement which have been recommended and inaugurated by the commission. Opinions differ as to their relative value, but in my humble judgment each of the three has its own specific usefulness—the levees for general conservation, the contraction works for local concentration, and the revetment to secure the permanence and augment the results of the other two. As means to the grand end these three are inseparable."

In connection with these improvements,

AN EXTENSIVE PLANT

was required, much of which had to be designed, and all of which had to be contracted for and built. Although a large sum was spent for that purpose before the work began, the appliances were inadequate, and have been largely increased since. Nearly all the channel work is done from boats, and a great part of it with machinery. A description of operations, as they were conducted in 1885, says that "there are floating pile drivers that drive piles in water 20 feet deep, and into the ground 20 feet, without a stroke of the hammer, by means of a hydraulic jet. There are snag boats that will jerk a snag out of a bank in less time than a dentist will extract one from a jaw. There are hydraulic graders that grade caving banks to a flat slope with water jets, at a cost of 3½ cents per cubic yard, a work which would cost from 12 to 20 cents if done with shovel and spade. There is a mattress boat, carrying a steam loom, which, being fed wire and brush, turns out a continuous woven mattress 130 feet wide and of unlimited length. There are floating machine and repair shops; floating boarding houses, with appliances for feeding and lodging, all told, nearly 2,000 men, and stone, brush, and coal barges in great number. The entire plant, as now organized, not including snag boats belonging to the United States, or chartered tow boats, embraces 189 barges, 62 pile drivers, 25 mattress boats, 39 quarter boats, 5 tow boats, 4 screen boats, 3 machine-shop boats, 4 graders, 1 pumping boat, and 1 steam tug, making 333 in all, and representing a cost of over a million of dollars."

THE TRIBUTARIES OF THE MISSISSIPPI.

The length of the navigable portions of the Mississippi, and of rivers flowing into it which are or presumably can be made navigable by sufficient outlays, was described as follows in one of the reports of the Mississippi river commission:—

Rivers.	Miles.	Rivers.	Miles.
Missouri	3,127	Cumberland	653
Mississippi	2,166	White	460
Ohio	1,021	Washita	445
Red	820	Yellowstone	438
Tennessee	759	Wabash	369
Arkansas	668	Allegheny	325
Minnesota	295	Chippewa	90
Illinois	269	Iowa	80
Yazoo	240	St. Francis	80
Osage	237	St. Croix	65
Sunflower	207	Rock	64
Tallahatchie	200	Kentucky	60
Green	200	Black (Louisiana)	54
Wisconsin	160	Big Horn	50
Black (Arkansas)	136	Clinch	50
Monongahela	110		
Kanawha	94	Total	14,086
Muskingum	94		

The mileage, as given in the above table, is to the head of navigation. In most instances that means continuous navigation, but not always so. For instance, the navigation of the Mississippi is broken at St. Anthony's Falls, and then is resumed and extends to Sauk Rapids. In the Tennessee river there is an interruption at Muscle Shoals in the state of Alabama, and another below Chattanooga. In the Red river there is also an interruption of continuous navigation. But these breaks in continuous navigation exist only in a few of the above tributaries, and can be overcome.

The navigable portions of this river system either intersect or border eighteen states and two territories. The mileage of the navigable portions of the system which cross or border each state is nearly as follows:—

States.	Miles.	States.	Miles
Arkansas	1,826	Minnesota	660
Missouri	1,504	Wisconsin	560
Louisiana	1,314	Ohio	556
Montana	1,311	Nebraska	400
Illinois	1,277	Pennsylvania	380
Tennessee	1,220	Texas	300
Mississippi	1,207	Dakota	285
Kentucky	1,187	Alabama	250
Iowa	845	Kansas	190
Indiana	840	West Virginia	104

Nearly all the large tributaries of the Mississippi are being improved, in various ways, at the national expense. Special efforts are made to secure extensive improvements on the lower and upper Mississippi, the Missouri, and on the Tennessee, particularly with reference to the removal of shoals or other obstructions from that river.

IMPROVEMENT OF THE MISSOURI.

An interesting description of the methods adopted on the Missouri, written for the American Engineer, of Chicago, by L. E. Cooley, resident engineer at St. Charles, Missouri, commences with the following graphic sketch of some of the difficulties encountered at the outset:—

"Of all the detrital streams of this country of commercial pretensions, the Missouri has relatively the greatest slope, with all the evils that this implies in a rapid current, broad and shifting bed, accompanied by sand-bar and reef formation, and heavy and apparently erratic bank erosion. Its phenomena are radically developed, and to the novice its course is entirely whimsical. To the land owner it is an unchained terror, with a mortgage on every foot of land between the bluffs, which it is sure some day to foreclose. Out at its mouth it throws from one-half to a cubic mile of detritus each year, from 10 to 20 per cent. is in suspension, and the balance rolled along or drifted in the vicinity of the bottom. With this passes out the spoils of the land, drift logs and trees in great quantity, while disseminated everywhere through the water, and scarcely noticeable, is an untold quantity of fibre in the shape of grass-blades, rootlets, leaves, &c.

Place at some characteristic point a young engineer, fresh from *alma mater*, who probably has never seen this stream before; let him be conscious of knowing nothing about river improvement, and be told by his superior officer that this is the reason for his selection, and that previous experience would be a damage to him; let local interests demand a change to an old course which the river has been a generation in leaving; let local experts, retired pilots, flatboat and raftsmen, and oldest inhabitants, whose lands have been cut away, tell him how to do it, and the town council resolve on the matter; let a railway company be vitally interested, and steamboat interests captious; let engineering requirements demand the complete rectification of ten to twenty miles of river, costing $15,000 to $20,000 per mile, and only $10,000 to $15,000 available, with almost a certainty that the best work that can be placed for this amount will be turned on both flanks by the untrained stream; let methods be experimental, the results uncertain, and the engineer obliged to furnish some assurances of success; let 'men of influence' come around, and tell how much they had to do with getting the appropriation, and how much they expect to do in future appropriations, and introduce their chief henchmen with bids for material at three prices, while the lesser lights urge their fitness for foremen and inspectors; let general opinion assume that if he is not a peculator and thief he is misusing opportunities, and finally let him be saddled with a system of bureaucracy with which he is not familiar, and some slight conception may be formed of the position of the engineer in charge of works on the Missouri river three years ago, at the inception of present improvements.

Notwithstanding all this a substantial progress and development has been made. Popular opinion is less skeptical and is gradually educating to an appreciation of the purposes which an improvement should serve. In the development of experimental methods failure has been more conspicuous than success; this failure is necessarily incident to all experiment, but it has been most often due to inadequate funds. Failure and success have been carefully studied, improvements and new devices introduced, until at present a well-defined system is clearly in view which a couple of years will doubtless develop into a standard practice. Even now some reasonable assurance can be given of the possibilities of a project and the cost of its execution.

Based on the physical studies of the resident engineers and the probable outcome of present methods, Major Suter has estimated the cost of a permanent improvement that shall control the stream, lessen flood and ice dangers, and provide ten feet navigable depth from the mouth to Sioux City at all seasons—781 miles, at $8,000,000."

GENERAL SYSTEM OF WESTERN RIVER IMPROVEMENTS.

The article from which the above extract is made also contains the following statements:—

"The history of western river improvement by the General Government, if we except the Ohio and tributaries, is quite recent, and its development still in its infancy. Previous to 1871 appropriations were almost entirely limited to snagging and the removal of channel obstructions, and these operations have attained such a degree of perfection as to leave little to be desired.

Aside from this, proper works of correction and conservation were entirely due to private or corporate enterprise, if we except $75,000 appropriated for the harbor of St. Louis from

1834–44. By the city of St. Louis alone up to 1870 about $900,000 had been expended, and in addition large amounts by ferry and transfer companies for the improvement of its harbor. These works were the most noticeable of this period. In the long run, they were measurably successful in accomplishing in part the objects desired, but only through persistent effort and expense during a long series of years.

Most of the work on the Missouri previous to 1877 was due to corporate enterprise, and was for the correction and protection of bridge sites, railway transfers, city fronts, and the protection of railway alignment in the valley. So far as these works have been successful in aggressive localities they have been maintained at constant expense, but more frequently they have failed entirely or been left inland, and probably the aggregate damage from them has outweighed the benefits. Even the best of them, the Mason dykes at St. Joseph are now entirely destroyed, and the Kansas City works required reinforcement, due to the great rise of this spring.

The character of all these works was essentially the same, consisting generally of loose rip rap sometimes in conjunction with piling and brush, and occasionally on brush foundations alternated with layers of brush; for shore revetment a facing of loose rock sometimes in conjunction with loose brush in the hope that in some mysterious way the seat of disease would be reached. These works call for no special comment. Each piece seemed to be placed according to the judgment of the individual in charge without special reference to the experience elsewhere, if indeed it was known. It appealed to the 'common sense' of the locality interested, and the same methods are still uppermost in the mind of the average layman and man of influence. The experience of this period is almost entirely negative in value.

River improvement proper was initiated by the General Government on the Wisconsin and Illinois in 1870–71, the Upper Mississippi in 1874, the Middle Mississippi, or between the Illinois and Ohio, in 1872–73, the Arkansas and Missouri in 1877, and the Lower Mississippi at Memphis and Vicksburg in 1878.

The works on the Wisconsin, Illinois, and Upper Mississippi have taken the direction of dyke works, in dams and wings, and incidentally on the latter stream, of revetment. These works are constructed, for the most part, of brush fascines or small mats in conjunction with rip rap or loose rock, modified according to resources or exigencies, and the present development seems to be satisfactory to the officers in charge. The system is here certainly permissible, but furnishes no precedent for streams of positive detrital character and mobile strata of unlimited depth."

GOVERNMENTAL CANALS.

Partly incidental to river, harbor, and lake improvements, and partly as independent propositions, something has been done and much more has been proposed, in the way of securing congressional appropriations for the construction of free canals. The most important works of this class in actual operation are the Louisville and Portland Canal and canal improvements on the lakes, by which the tonnage of the vessels that can safely traverse them has been increased from a few hundred tons to several thousand tons.

The Louisville and Portland Canal was built in 1825, by the Louisville and Portland Canal Company, under a charter from the state of Kentucky to construct a canal around the falls of the Ohio, near Louisville, at a cost of over $1,000,000. In this company the United States was an original stockholder to the amount of $233,500. The Federal Government gradually purchased with its accrued dividends the residue of stock. In the year 1846 it had purchased the greater portion, and at the close of the year 1855 it owned the whole of the property except five shares valued at $500. Subsequently these five shares were bought, and on the 11th of June, 1874, the Government assumed and has ever since retained the sole management and control. The Louisville and Portland Canal is the connecting link in the great chain of water communication furnished by the Ohio river. During a recent year over three thousand boats and barges passed through its locks. The number of tons carried by these boats was 999,610. Up to the 11th of June, 1874, the tollage paid by all vessels propelled by steam was 50 cents per ton. From the year 1831, when the canal was first opened for business, to 1872, tolls received amounted to $5,157,247. After the Government assumed control tolls were reduced to one-fifth of the former amount, but even with this reduction over three hundred thousand dollars was collected, and subsequently all tolls were abolished.

Of channel improvements on the lakes it is stated that the "draught of the larger vessels has always been controlled in a great measure by the depth of water on St. Clair Flats. Previous to 1858 this was only about 9½ feet, and by way of the North Pass. Improvements at the South Pass, completed about that time, afforded a depth of about 12 feet, and shortened the distance. In 1871 the St. Clair Flats Canal, with a depth of 13 feet, became available. This was increased in 1874 to 16 feet. As these successive improvements were completed, the channel entrances to the important lake harbors were correspondingly deepened, and vessels were constructed to utilize this increased depth of the channels. But the full effect was not felt until after the completion of the enlargement of St. Mary's Falls Canal in 1881. Previous to that time the depth of water in the canal was 12 feet. It was increased to 16 feet. In 1864 the average registered tonnage of vessels passing the canal was 405 tons. In 1882 this had increased to 560 tons."

In 1885 some of the lake vessels carried 3,000 tons, and additional improvements, intended to deepen channels to 20 feet, were progressing, which were expected to lead to the use of some vessels with a carrying capacity of 4,000 tons.

In addition to these works, a considerable number of canal projects have been proposed, and congressional aid on their behalf has been earnestly solicited. The list includes the Hennepin Canal, by which a free channel would be furnished for 280-ton boats or vessels between the Mississippi, at Rock Island, and lake Michigan, at Chicago; the construction of a ship canal between the Chesapeake and Delaware bay, which would furnish a more convenient outlet for the commerce of Baltimore; the enlargement and maintenance of the Erie Canal, and divers projects for constructing artificial water channels between the Mississippi valley and the Atlantic seaboard in sundry states, including Pennsylvania, Virginia, and Alabama. One of the features of these propositions is the manifestation of great readiness on the part of states which own canals or river improvements to transfer title to the United States, if it will assume the responsibility of maintaining and improving these works, and making them available for navigation free of tolls and all other charges for their use.

UTILITY OF WATER-WAY IMPROVEMENTS.

MANY efforts have been made to cheapen the cost of transportation to the persons and interests directly benefited or to be benefited by artificial channels, through the financial process of throwing the burden of the principal or interest of large sums upon the main body of national tax-payers. To some extent this may be true of all important river and harbor improvements, and how far congressional appropriations for such purposes are proper or improper, and just or unjust, largely depends upon the extent to which the advantages secured in each case are of a thoroughly national character, and how far the general workings of the systems of water improvements, practiced and proposed, actually do redound to the welfare of all classes and sections.

It is obvious that there should be a dividing line somewhere, and that the topography of a very large proportion of the country is such as to render it impossible to confer upon many sections, districts, and interests direct and palpable benefits, in the way of cheapening and increasing their facilities for transportation, by any known or practical descriptions of water-way improvements of sufficient importance to correspond fully with the benefits that may possibly be conferred upon other sections or interests. It is also evident that the relative significance of all interior water channels has been greatly diminished since the period when they formed the only possible outlet for cheap and bulky products, and since many extensive rail movements have been conducted at lower rates than could formerly be obtained from any of the common carriers on rivers or canals.

For these and other reasons, sundry

ARGUMENTS IN SUPPORT OF VARIOUS WATER SCHEMES

proposed have been advanced. Their leading feature is based on the assertion that water-route charges form the great regulators of the cost of through-freight movements, and that, by cheapening the cost of lake, river, and canal transportation, a permanent check on rail charges will be established. One of the advocates of such views says:—

"In a newly-settled country the natural water courses are the only highways available for heavy transportation. As population increases and the country is developed, railways are built, and, for a time, they can do all the business required, thus apparently superseding water transportation altogether; but as the wealth and density of population still further increase the necessity for water transportation again asserts itself. So true is this that now on all sides we find a cry raised for the improvement and greater use of water-ways. The necessity for paying increased attention to our inland navigation has been forced upon the public in this country by the combination which railway companies have managed so skillfully to arrange and work for their exclusive benefit. It is not in this country alone, however, that a tendency to revert to the older means of transit is noticeable. Throughout the world of commerce the desire for more direct means of conveying goods in bulk prevails.

Among the advantages of river improvements may be mentioned: 1. They furnish means for the transportation of heavy and bulky commodities, such as coal, iron ore, scrap and pig iron, stone, and timber, which often will not pay the cost of transportation by rail. 2. They keep in check the grasping tendencies of railway companies by controlling freight rates and facilities."

On the other hand, the belief is expressed by various persons that the real importance of many of the internal water routes for the improvement of which large appropriations are made or solicited has been greatly exaggerated; and that in cases where these appropriations represent considerable sums the outlays would be more effective, for genuine transportation purposes, if the Government would construct and operate railways, free of charge, on a number of the contemplated routes. As a matter of fact the relative utility and importance of internal water carriers has been steadily declining with the expansion of railway systems, and it is mainly on the lakes, the ocean, the gulf and tidal rivers that such declines have not occurred to a notable extent.

DECLINE OF STEAMBOATING ON THE MISSISSIPPI.

A graphic picture of what has occurred on the upper Mississippi is furnished by the following report of remarks by a railway official, printed in a journal published at St. Paul, the head of navigation on that river:—

"There is not half the benefit derived from the Mississippi river that the people are led to believe. The railroad companies carry freight at as low a rate as the boat lines, and besides give better service by fast time and prompt delivery. The boats do very little, if any, through business. It is only local traffic they carry. And what town of any size along the river is not touched by a railroad? There is a sufficiency of roads to transport all the produce the country furnishes, and the competition among them keeps the rates on a basis with that charged by the boat lines. If the railways did right they would compete with the boat lines while navigation is open in such a way as to surprise them, and compel them to tie their boats up to the nearest swing bridge on the river, and in the winter make the shippers who were inclined to favor boat against rail pay such a rate on every article they ship that it would draw the life-blood from their hearts. The railroads are in a position to do it if they wanted to. But they were built for public benefit, and they did not apply to Congress every year for aid, or a certain sum of money to maintain them and make necessary improvements.

No; when boat lines can perform the service of a well-managed road extending along the river bank the same distance as the boat lines run, then it is time canals were run all over the country, and the first man to mention railroads should be lynched. Of course the Mississippi river is a strip of water owned by the Government, and the Government does not want to see it become clogged with snags, or mountains growing in its centre, or resting places for ducks and geese. No; it must be kept in a proper light before the public, especially foreigners, so that the historical Mississippi may appear to them all that has been said of it. If it is kept in an improved condition, and the boats run regularly between points, the railroad companies do not care, for their traffic is not noticeably diminished by the competition. None of the companies owning a line of boats running between St. Louis and St. Paul find them paying. I'll bet you they are losing money every day, but continue to run in the hope of better times. There is no through business between St. Louis and St. Paul to speak of, and the result is that the boat lines depend almost entirely for the trifling business picked up between points, for which they ask what a railroad man would call a very remunerative rate. This is why we do not believe in Congress appropriating money for the improvement of water-ways, because it does not really benefit the country tributary to the point where the improvement is made when there is a railroad in that district, for the railroad can carry all the business at as low a rate in the end to the shipper as the man owning the boat can. This, then, is only beneficial to the few individuals who own the boat transportation lines, and when Congress makes an appropriation for the opening of canals and rivers it is for the benefit of a certain few individuals who wish to embark in new enterprises aided by the public."

In discussing the decline of steamboat movements on the lower Mississippi a New Orleans journal states that "thirty-two steamboats traded from St. Louis to New Orleans in the year 1859, with a total tonnage of 48,800 tons, all fine passenger steamers. This was the grand era of steamboating during the fifties up to 1861. The war coming on crippled the trade.

After the war came the railroads, and they have almost swept it away from this city. We have now five steamers in the trade with a capacity of 10,000 tons, not one-fourth of the tonnage during the ten years mentioned above. If this does not demonstrate the loss of the steamboat trade to this port, then we are mistaken. In 1859 the steamboats trading between Cincinnati and New Orleans embraced 36 steamboats, with a total tonnage of 25,000 tons. All these steamers were in the Cincinnati and New Orleans trade from 1859 to 1861. This was the great era in the New Orleans trade. Now we have in this trade say eight boats, whose aggregate tonnage amounts to 10,000 tons; this shows a decrease of 15,000 in this trade, and every year the railroads are making greater inroads upon the trade, so that in a few years steamboats will disappear entirely from the Cincinnati and New Orleans trade."

There has also been a very extraordinary diminution of the relative magnitude of steamboat movements in comparison with rail movements at St. Louis.

BARGE MOVEMENTS ON THE MISSISSIPPI.

While there has been a marked decline in steamboat movements on the lower Mississippi, the improvements in navigation or other causes have led to an extensive development of barge movements by which large quantities of coal and grain are moved down the river, tow boats furnishing the motive power. There was a very notable increase in the south-bound river movement of grain from St. Louis to New Orleans during the ten years ended in 1880, principally on account of the rapid growth of barge and barge-line movements. During 1880 the rates on bulk grain per bushel, St. Louis to New Orleans, ranged from 7 to 9½ cents per bushel. River insurance from 60 to 75 cents per $100.

LEADING INFLUENCES OF THE EIGHTH DECADE.

THE BEGINNING OF A NEW ERA.

THE railway development of the eighth decade was affected by many powerful influences, which led to remarkable results in the way of reducing the cost of transportation, increasing the efficiency of passenger as well as freight service, and advancing the entire range of the appliances of the roads engaged in important competitive service. It may be said that railway arrangements, as they are now understood and applied to the immense labors performed, only fairly commenced in or shortly before 1870. There had, of course, been a protracted series of preparatory efforts. Little by little, and step by step, each of the innumerable details on which genuine advancement depends had gradually been improved by progressive lines. But the decisive advances, by which immense forward strides were made within a brief period, and the best types of American railroading rendered far superior to those of any other country in their relation to the most pressing popular requirements, occurred after the close of the seventh decade. It is not pretended that every railroad and all its appliances were suddenly improved, for a considerable portion of the aggregate mileage of American lines is chronically in a financial condition that forbids sweeping changes, either on account of lack of money or a determination to adhere to old methods that have proved profitable. But the important representative companies that usually lead the van of railway progress found themselves confronted with so many difficulties, including those arising from their own intense rivalries, the popular demand for cheap transportation from the granger regions to the seaboard, the threat of congressional support of a new rival through-rail line, and certainty of large national appropriations for the improvement of competitive interior water routes, various forms of legislative antagonism, and the money pressure overshadowing the entire country which was produced by the war debt and the struggle to resume specie payments, that they were obliged to devise methods for eking out sufficient profits to pay the interest on an enormous amount of capital from charges that fell far below the absolute cost of movements in former periods.

Under the stimulus typified by the phrase, "necessity is the mother of invention," a number of lines were equal to the occasion; others were subjected to the penalty of bankruptcy, but the obstacles overcome were so numerous that the managers who succeeded best hailed the triumphant results with even more of a feeling of gratified surprise than of satisfaction.

The most powerful single agent in promoting improvements was steel rails, but they could not, and did not, in themselves, secure more than a fraction of the advances that were required. It was necessary that the standard of all other essential mechanical and engineering devices, including terminal facilities, should be rapidly raised; and, in addition, that the manner of making up and moving trains, and commercial and rate-making systems, should be radically modified. To do all that was necessary, and yet to avoid doing anything seriously injurious required an amount of administrative talent rarely or never displayed in connection with the governmental operations of this or any other country.

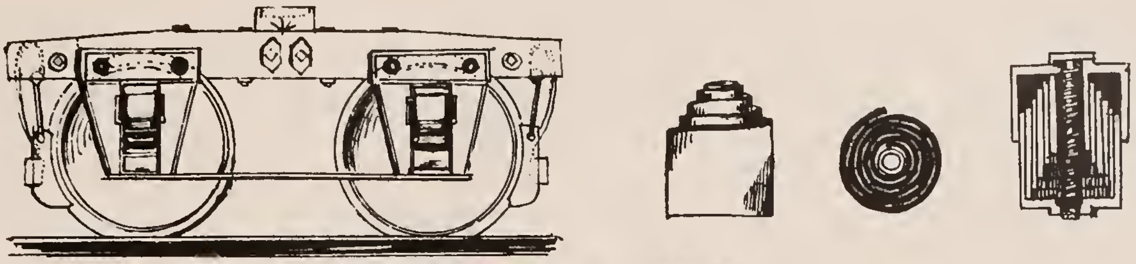
The principle of

STIMULATING AND ENCOURAGING COMPETITION

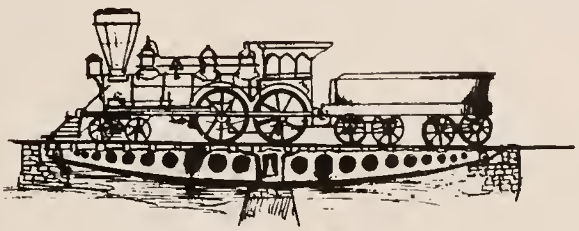
had been applied to the transportation affairs of the United States to an extent unknown elsewhere. It is the only thing communities and governments fully believe in as an effective agent in securing such service as they desire. This is the meaning of the wide latitude given to scheming speculators by free railroad laws, legal prohibitions of the consolidation of competing lines, of the delight with which announcements of railway wars has frequently been hailed, of the popularity of unnecessary new competitive routes. The Windom committee of 1873 announced that it was unanimously of the opinion that "the problem of cheap transportation is to be solved through competition;" and this declaration was followed by the recommendation that a number of expensive projects should be supported by the National Government, on the ground that "the only means of securing and maintaining reliable and effective competition between railways is through national or state ownership, or control, of one or more lines, which, being unable to enter combinations, will serve as regulators of other lines." The fallacy of the latter assertion has been demonstrated, and reckless competition has so often engendered serious evils that faith in it has been somewhat weakened, at least to the extent of favoring the application of checks to extravagant demonstrations; but competition, more than anything else, has been the mainspring of exceptionally active efforts to cheapen transportation, and it would be much easier at the present day than it was during the early years of the eighth decade to find any considerable number of popular authorities ready to question the propriety of governmental encouragement of all forms of available competition in matters relating to freight movements.

There can be little doubt, that in its bearing on the vital interests of a large proportion of the American people, especially those who reside at or near non-competitive points, this principle has been carried to damaging lengths; and many efforts have been made, during the last two decades, to devise remedies for injurious excesses; but at the beginning of the eighth decade this phase of the subject attracted comparatively little attention, even in railway circles, and competition, by land and water, between rival rail routes, between rival water routes, and between rival combined rail and water routes was generally regarded as the paramount requirement of the period, for which progressive railway companies were making every possible preparation.

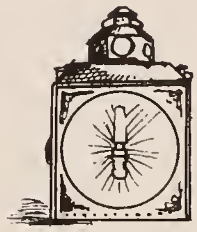
These efforts are partly represented on the New York Central by the stupendous scheme of laying down four parallel



Conical Volute Car Spring.

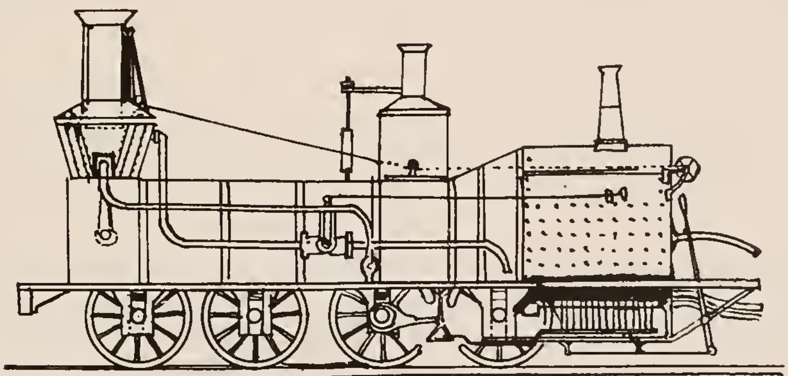


Sellers' Cast Iron Turn-Table.

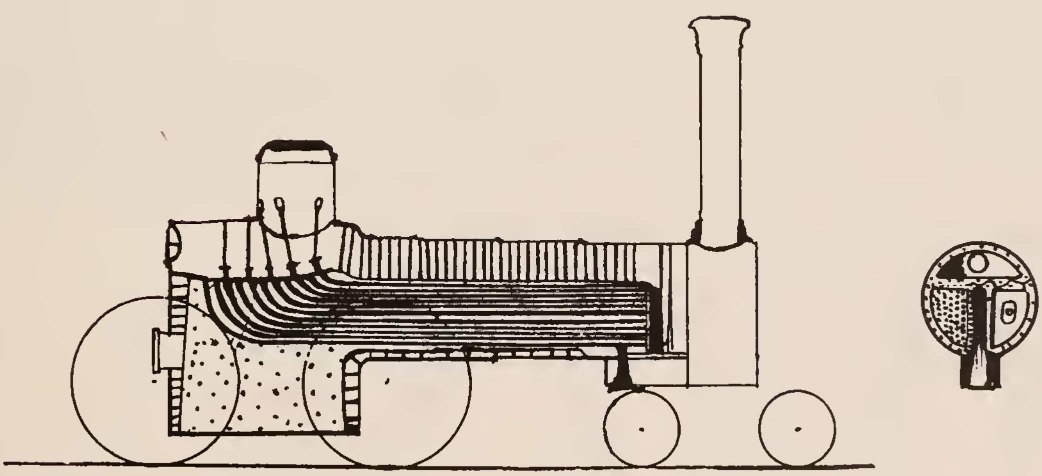


Head Light.

Lamp.



Coal-Burning Freight Engine.



Dimpfel's Boiler.

RAILWAY APPLIANCES OF 1857.

steel rail tracks at a time when steel rails were selling at an enormous price; on the Pennsylvania by the acquisition of the New Jersey lines, by which a controlled entrance to Jersey City was obtained; the rapid adoption of many notable improvements relating to all details of organization, permanent way, and rolling-stock affairs; on the Baltimore and Ohio by the construction of bridges over the Ohio river, the extension of lines to Chicago, and sundry expansions of its system in Western states; and on various other roads by improvements and new construction of great magnitude.

So far as the action of governments on general transportation questions since 1870 is concerned, the inner meaning of the bulk of their proceedings is substantially this: By their staple policy of encouraging excessive competition, even by questionable methods, they inevitably generated the class of evils known as unjust discrimination against sections and individuals, and having laid a broad foundation for their creation and perpetuation, numerous quack remedies have been devised and applied with about the degree of success that ordinarily attends empiricism.

Modern transportation history is largely made up of

CHANGES RUNG ON TWO GREAT KEY-NOTES,

one of which is the marvelous lowering of charges between competitive points, or to shippers who forward immense quantities, and the other of complaints that these reductions have not everywhere progressed with uniform rapidity in their application to all localities and classes of shipments. There are legitimate reasons for many of these distinctions or discriminations, while others may be unwarranted, and such a variety of considerations bear on the main question that it would often be exceedingly difficult for unprejudiced persons, who gave due heed to all pertinent evidence, to decide whether practices complained of were just or unjust.

The fact that one locality is a competitive point while another is not, implies that a relatively large amount of traffic accumulates at the former and not at the latter, and probably the most important of all elements of cheapness is quantity, so that for this reason, if for no other, the carrier can afford to reduce mileage rates to shippers residing at competitive points. The force of this consideration is greatly increased by the economics arising from terminal facilities which diminish cost of loading and unloading, and from the reductions in the proportionate value of clerical service at places where a large amount of business is transacted. The distinctions between the charges at competitive and non-competitive points, which are based on absolute differences in cost to the carrier would, however, scarcely have given rise to all the violent anti-discrimination agitations in various states, if competition between rival lines for traffic centreing at competitive points had not frequently carried down rates to figures far below those which would fairly represent the actual reduction in cost arising from concentrations of large amounts of freight, and if large quantities of freight had not often been carried at rates that fell below the cost of such movements.

THE GREAT DEVELOPMENTS

which have left a permanent impress are, first, the rapid extension of railway lines to all portions of the country, and improvement of their appliances; second, the continuous cheapening of the average rates of important lines; third, the exceedingly and injuriously low figures to which reductions of rates between leading competitive points have frequently been carried during eras of railway wars; fourth, efforts to prevent such reductions from reaching ruinous proportions; and fifth, the real and pretended grievances, and corresponding agitation and legislation, which excessive and unremunerative reductions in rates have occasioned.

MAGNITUDE OF RAILWAY OPERATIONS.

THE records of new construction already printed afford a vivid idea of the rapidity with which railway systems were expanded during the eighth decade, but additional indications of their magnitude are furnished by statements in the census statistics of railroads for the year ending June 30th, 1880, which show that at that time the mileage operated was 87,801.42, of which 44,290.99 miles had been completed after January 1st, 1870; that the reported cost of the permanent investment of this property was $5,182,445,806.93, including roads, equipment, lands, stocks, bonds, telegraph lines, and miscellaneous, and that these outlays were represented by $2,613,606,264.45 of capital stock, $2,390,915,401.63 of funded debt, and $421,200,893.56 of unfunded debt. The valuation of the assets of the whole system amounted to $5,536,419,787.74, and the actual liabilities to $5,425,722,559.54, which left $110,697,228.20 as profit and loss to credit for the combined roads. The labors performed by all these railways during such of their fiscal years as corresponded most closely with June 1st or June 30th, 1880, included the carriage of 290,897,395 tons of freight over an average distance of 111 miles, equivalent to the movement of 32,348,846,693 tons one mile. The average receipts for this service were 1.29 cents per ton per mile, and the aggregate revenue, $416,145,758. The cost, exclusive of interest on capital, was 0.76 cents per ton per mile, and the net receipts, 0.53 cents. The number of passengers carried was 269,589,340; the average distance carried was 21 miles; the movement was equivalent to the transportation of 5,740,112,502 passengers one mile; the aggregate revenue was $144,101,709; the receipts per passenger per mile were 2.51 cents; the cost, exclusive of interest on capital, was 1.71 cents, and the profit, 0.80 cents.

The rapidity of the railway development during the eighth decade is shown by the following:—

Statement Showing Miles of Railroad, Capital Account, Earnings, Dividends, &c., as Reported in Poor's Manual for the Years Named.

Year.	Miles operated.	Capital and funded debt.	Total earnings. Gross.	Net.	From freight.	From passengers.	Dividends paid.
1871	44,614	$2,664,627,645	$403,329,208	$141,746,404	$294,430,322	$108,898,886	$56 456,681
1872	57,323	3,159,423,057	465,241,055	165,754,373	340,931,785	132,309,270	64,418,157
1873	66,237	3,784,543,034	526,419,935	183,810,562	389,035,508	137,384,427	67,120,709
1874	69,273	4,221,763,594	520,466,016	189,570,958	379,466,935	140,099,081	67,042,942
1875	71,759	4,415,631,630	503,065,505	185,506,438	363,960,234	139,105,271	74,294,208
1876	73,508	4,468,591,935	497,257,959	186,452,752	361,137,376	136,120,583	68,039,668
1877	74,112	4,558,597,248	472,909,272	170,976,697	342,859,222	130,050,0[illegible]0	58,556,312
1878	78,960	4,589,948,793	490,103,351	187,575,167	365,466,061	124,637,290	53,629,368
1879	84,233	4,762,506,010	529,012,999	219,916,724	386,676,108	142,336,191	61,681,470
1880	92,146	4,897,401,997	613,733,610	272,430,665	467,748,928	147,653,003	77,115,371

Of all the transportation service rendered for the American people by common carriers, moving over land and water, an immense proportion is performed by railways. A number of water carriers, however, are active and successful competitors for business that can be transacted over canal, river, lake, gulf, and oceanic routes. The figures already given in regard to the railway freight and passenger movements of 1880 show their magnitude. Details relating to the character of the freight moved and routes selected are also furnished by the census statistics in the following table:—

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FREIGHT TONNAGE—CLASSIFICATION OF ARTICLES CARRIED.

Article.	Group I.	Group II.	Group III.	Group IV.	Group V.	Group VI.	Aggregate for the United States.
Aggregate	24,978,661	192,446,645	15,866,552	45,407,775	750,601	11,447,161	290,897,395
Grain	2,767,334	23,993,678	1,097,200	12,273,096	5,646	1,866,550	42,003.504
Flour	1,223,495	3,864,557	352,462	1,787,172	8,541	213,490	7,449,717
Provisions	1,004,247	4,373,741	638,649	814,758	22,987	245,143	7,099,525
Cotton	502,708	957,453	1,679,715	362,003	96,496	360,020	3,958,395
Live stock	766,271	5,073,225	543,055	3,711,344	16,617	703,707	10,814,219
Stone, lime, cement, clay, and sand	987,709	6,292,027	336,364	1,095,176	6,128	282,918	9,000,322
Lumber and other forest products	2,395,090	13,019,552	1,757,231	6,447,585	29,265	1,825,626	25,474,349
Coal	2,673,998	76,470,439	2,479,305	6,692,437	4,664	1,302,056	89,622.899
Petroleum	207,431	7,342,843	52,336	72,656	1,165	38,461	7,714,892
Pig, bloom, and railroad iron	545,794	8.133,842	529,044	2,153,325	871	300,496	11,663,372
Manufactures	3,653,515	11,398,882	452,942	1,919,191	41,646	267,387	17,733,566
Merchandise and miscellaneous	8,251,069	31,526,406	5,948,249	8,079,029	516,575	3,974.590	58,295,918
Unspecified	....	....	....	....	......	66,717	66,717

DISTRIBUTION OF TRAFFIC BETWEEN THE VARIOUS GROUPS.

It is obvious that great differences exist in the amount of traffic per mile of existing roads in the various groups, and this difference is even more perceptible in a table relating to diversity of traffic, and number of tons hauled one mile, than in the above statement of the number of tons moved. It shows that of the aggregate movement, in ton-miles, nearly two-thirds was performed by 28,693 miles of railway located in group II, and that the entire movement was so distributed that the equivalent of the number of tons carried the whole length of the road in each direction daily was in the entire Union 505 tons, and in the various groups as follows: Group I, 324 tons; group II, 975 tons; group III, 159 tons; group IV, 381 tons; group V, 41 tons; group VI, 201 tons. This table shows that the average amount of freight moved daily on all the roads of any section was not as large as the load now frequently drawn in a single train headed by a consolidation engine, and that the average daily freight movement in one group, in each direction, was not more than a sufficient load for early locomotives of past decades. The contrast in the passenger movements of roads of various groups is somewhat less striking, but the difference is great, as it ranges from the equivalent of 25 passengers moved in each direction over the entire length of the roads in group V, daily, to the equivalent of 204 passengers carried the whole length of the road in each direction, daily, in group I.

If this was not a rapidly-growing country, and if many railways had not been built through sparsely-settled districts, with the expectation that population would be attracted by railway exertions and facilities, it would be one of the greatest of financial mysteries why they were constructed through regions which do not furnish more business than the equivalent of moving 25 passengers and 41 tons of freight over the entire length of the roads in each direction daily. Such an amount of traffic requires, to defray the interest at 6 per cent. on the cost of lines capitalized at $25,000, a profit of about 3 cents per ton and 3 cents per passenger on the cost of the lines per mile.

The paucity of the traffic of many sections and of the entire mileage of the country helps to explain the anxious desire of the managers of all lines to attract such new business as can be furnished only by participation in through movements, even when that object can only be attained by enormous concessions in average rates per ton or per passenger per mile.

Another striking feature of the census report is its statement that notwithstanding the multiplicity of railway companies, 44 corporations conducted, in 1880, 80.4 per cent. of the whole freight traffic and nearly 60 per cent. of the railway passenger business of the country, and that their average freight rates were considerably below those charged by the other companies. The names of the 44 active organizations and their relative amount of freight business are shown in the following table:—

FORTY-FOUR CORPORATIONS HAVING OVER 100 MILLION TON-MILES EACH.

Companies.	Ton-miles (local and through).
Aggregate of 44 companies	26,015,488,025
Pennsylvania	3,165,725,856
New York Central and Hudson River	2,525,139,145
Baltimore and Ohio	1,725,855,440
New York, Lake Erie and Western	1,721,112,095
Lake Shore and Michigan Southern	1,786.183,362
Chicago, Burlington and Quincy	1,173,001,695
Wabash, St. Louis and Pacific	947,369,587
Philadelphia and Reading	834,431,965
Chicago and North-western	816,739,941
Pittsburgh, Fort Wayne and Chicago	766,011.289
Michigan Central	727,254,789
Chicago, Rock Island and Pacific	664,861,579
Lehigh Valley	592,369,479
Delaware, Lackawanna and Western	580,454,696
Central Railroad of New Jersey	518,117,193
Chicago and Alton	462,829,875
New York, Pennsylvania and Ohio*	456,094,920
Central Pacific	449,580,783
Chicago, Milwaukee and St. Paul	442,907,736
Union Pacific	436,054,149
Columbus, Chicago and Indiana Central	415,456,386
Cleveland, Columbus, Cincinnati and Indianapolis	411,741,819
Pittsburgh, Cincinnati and St. Louis	381,195,157
Boston and Albany	375,452,804
Illinois Central	335,470,860
Northern Central	272,466,907
Atchison, Topeka and Santa Fe	266,174,880
St. Louis, Iron Mountain and Southern	253,070,858
Ohio and Mississippi	247,323,780
Chesapeake and Ohio	230,219,851
Louisville and Nashville	221,928,834
Missouri and Pacific	219,885,868
Missouri, Kansas and Texas	185,105,510
Cleveland and Pittsburgh	174,837,293
Kansas Pacific	157,143,428
Central Vermont	146,459,884
Marietta and Cincinnati	137,116,600
Albany and Susquehanna	128,044,683
Chicago, St. Louis and New Orleans	127,536,878
Hannibal and St. Joseph	111,987,174
Fitchburg	109,323,290
St. Louis and San Francisco	109,178,009
Allegheny Valley	103,641,884
Indianapolis and St. Louis	102,630,114

* Including six months' operations by the Atlantic and Great Western.

The above table does not fully illustrate the extent to which a large amount of the railway business of the country has been concentrated under the direction of a comparatively small number of systems, partly because some of the lines mentioned above form part of the systems of other lines embraced in the above list. A more striking illustration of the extent to which direct or indirect consolidations have been carried, largely because they are absolutely necessary to secure the combination of extraordinary cheapness in average rates per ton-mile with an avoidance of financial ruin, is shown in the following statement, which forms part of an important and interesting paper, prepared a few years ago by William P. Shinn, on the increased efficiency of railways for the transportation of freight:—

STATEMENT SHOWING LENGTH OF ROADS AND GROSS EARNINGS IN 1881 OF THIRTEEN SYSTEMS OF RAILROADS.

	Miles.	Gross earnings.
N. Y. Central and Hudson River	993	$29,322,532
Lake Shore & Michigan Southern	1,177	17,880,000
Canada Southern	403	3,369,259
Michigan Central	950	8,800,456
Total N. Y. Central system.	3,523	$59,372,277

	Miles.		Gross earnings.	
New York, Lake Erie & Western	....	1,020	......	20,715,605
Pennsylvania eastern system	3,041	....	$44.224,716	
Pennsylvania western system	2,529	....	31.058,790	
Total Pennsylvania system.		5,570		75,283,506
Total three trunk lines	$10\frac{7}{10}$	10,113	$21\frac{4}{10}$	$155,371,388
Wabash, St. Louis and Pacific	....	3,348	......	14,467,790
Chicago, Burlington and Quincy	....	3,160	......	21,176,455
Chicago, Rock Island and Pacific	....	1,335	......	11,956,807
Illinois Central Northern	1,320	....	$6,733,954	
Chicago, St. Louis & New Orleans Southern	571	....	4,059,151	
		1,891		10,793,105
Chicago and North-western	....	3,276	......	19,334.072
Chicago, Milwaukee and St. Paul	....	4,260	......	17,025,461
Missouri Pacific	1,012	....	$8,640,957	
Leased and controlled lines	4,773	....	19,087,484	
		5,785		27,728,441
Louisville and Nashville Railroad, and lines owned and leased by, &c.	1,872	....	$10,911,650	
Louisville, Cin. and Lexington	272	....	1,196,112	
Nashv., Chattanooga & St. Louis	521	....	2,256,186	
Georgia Railroad system	641	....	2,543,032	
		3,034		16,906,980
Union Pacific, proper	1,821	....	$24,258,817	
Lines in interest	2,449	....	7,608,936	
		4,270		31,867,753
Central Pacific	2,874	....	$24,094,10t	
Southern Pacific	1,281	....	3,435,945	
		4,155		27,530,046
Total, thirteen systems		44,627		$354,158,396
Total of United States in 1881, of which earnings reported	....	94,486	......	$725,325,119
Proportion thirteen systems bear to whole		$47\frac{23}{100}$		

REDUCTIONS OF RAILWAY RATES.

In view of the statements heretofore published relating to the cost and charges of freight movements by various methods, during succeeding decades, it is evident that no feature of modern progress affords greater cause for genuine surprise, or has exercised a more stupendous influence upon the entire industrial and commercial development of the United States, than the wonderful cheapening of average rail rates since 1870. If the full significance of the statistics bearing on this subject was fully understood, a better appreciation of the extraordinary and unprecedented achievements of the leading American lines would be secured. Whatever else may be said of their methods, no intelligent man can question the completeness of their response to the most imperative of all popular demands, which was for cheap transportation over long distances. Their daily tasks, as freight carriers, involve performances which would have been considered miraculous in any former age, and the aggregate railway lines actually perform, in productive labor, much more real work, so far as work can be measured by displays of physical force, than all other agencies combined. All things considered, they are the cheapest workers of the country, and if the theory favored by all influential schools of political economists, that transportation is one of the most important elements of production, is correct, they are, substantially, leading producers of all classes of bulky mining, manufacturing, and agricultural staples. It would be folly to pretend that they raise wheat, corn, or cotton, or make iron or textile fabrics, but it is indisputable that they furnish indispensable facilities, of great intrinsic value, for the performance of all important labors, by their cheap concentration of raw materials and distribution of the finished fruits of skilled industry; by forwarding the surplus yield of the farmer to market, and carrying back to him the wares of the manufacturer; by rendering possible any and every desirable accumulation of population at mining and commercial or other centres. Many of these labors would not be remunerative to shippers if they could not be performed at exceedingly low rates. To attract business, it is not only necessary that lengthy lines should be built or controlled, but that much freight should be moved for a small remuneration. Tonnage can only be materially increased by enormous diminutions of the standards of charges which formerly prevailed.

IMPORTANCE OF CHEAP TRANSPORTATION.

An ancient orator said that action, action, action, was the great requisite of success; and a famous warrior declared that money, money, money, was the thing which above all others he needed to achieve victories; so the active business men, and the leading industrial spirits of the United States, have been declaring ever since and even before the century began, that cheap transportation, cheap transportation, cheap transportation, was the most vital element of American progress. With cheap transportation the treasures of the mine, the bounties of the harvest, the fruit of the loom, the supplies and products of the furnace, can be moved over thousands of routes which are hermetically sealed to wagon-road and other high freight tariff operations. The dormant resources of innumerable localities can be profitably developed by the aid of cheap transportation, and never without its indispensable assistance.

It is only during a comparatively late era that average through rail rates have fallen to the low standard that now prevails, but the tendency towards a reduction has been so general on important lines, except when it was interrupted by such events as the substitution of greenback for gold valuations, or by temporary reactions, that irresistible influences have been promoting such reductions, the main agent being competition, not only between rival lines but between the competing regions they serve.

IN THE ENTIRE UNITED STATES

the conditions governing rates are so diversified, that a notable contrast in the average rates of different lines, and the lines of different groups, is inevitable. The extent and nature of these variations is indicated by the fact that the census report of 1880 on railways, shows the average receipts of all the rail lines of each of the groups in that year to have been as follows:—

Groups.	Receipts per ton per mile moved. Cents.	Receipts per passenger per mile moved. Cents.
I	1.83	2.23
II	1.02	2.21
III	2.15	3.51
IV	1.36	2.86
V	12 57	5.10
VI	2.57	3.43

The average receipts and cost (exclusive of fixed charges, &c.), of the combined lines of the country was as follows: Receipts per ton per mile moved, 1.29 cents; cost per ton per mile moved, 0.76 cents; net receipts per ton mile moved, 0.53 cents; receipts per passenger per mile carried, 2.51 cents; cost per passenger per mile carried, 1.71 cents; net receipts per passenger per mile carried, 0.80 cents. Since 1880 the average rate of the freight movement of all American lines has been materially reduced. In 1882 it was reported to be 1.2 cents per ton per mile. For subsequent years it was reported to be less than one cent per ton per mile.

One of the most striking condensed statements of the advantageous results of the cheapening of rates is the following made by Edward Atkinson:--

"Had the rates charged by the railways in the year 1881 been the same as the rates charged from 1866–69 inclusive (the latter being reduced to a gold basis), the sum of the charge of all the railways of the United States for moving merchandise in the year 1881

would have been	$1,375,000,000
It was in fact	550,000,000
The difference, amounting to	$825,000,000

exceeds the entire sum of all the national, state, and municipal taxes imposed upon the people of the country in the same year by the sum of $100,000,000. All taxes being about $725,000,000."

In an address delivered to the American Society of Civil Engineers by O. Chanute, in May, 1880, he furnished the following table of American railway average freight charges, expenses, and profit in the years named:—

	Year.	Revenue, cts. per ton-mile.	Expense, cts. per ton-mile.	Profit, cts. per ton-mile.
State of Ohio	1876	1.117	0.801	0.316
State of Michigan	1878	1.053	0.632	0.421
State of Illinois	1879	1.028	0.617	0 411
State of Massachusetts	1879	1 838	1.066	0.772
State of New York	1877	1.059	0.781	0.278
State of New York	1878	0 999	0.690	0.309
New York Central	1879	0.796	0 541	0.255
Erie	1879	0.780	0 561	0 219
Pennsylvania	1879	0.824	0.480	0.344
Boston and Albany	1879	1.073	0 622	0.451
Pittsburgh, Cincinnati and St. Louis.	1879	0.720	0.420	0.300
Columbus, Chicago and Ind. Central.	1879	0.700	0.590	0.110
Vandalia line	1879	0 931	0.715	0.216
Michigan Central	1879	0 692	0 407	0 285
Lake Shore	1879	0.642	0.399	0.244
Cleveland, Col., Cincinnati and Ind.	1879	0 687	0.575	0 122
Chicago and Alton	1879	1 054	0.558	0.496
Illinois Central	1879	1.520	0.610	0.880
Chicago, Milwaukee and St. Paul	1879	1.720	0.041	0.779

The United States census report on railways for 1880 reports the average receipts per ton per mile of fifteen of the largest freight carriers, representing different classes of roads, in the census year to be as follows: Pennsylvania, 0.89 cents; New York Central, 0.86 cents; Lake Shore, 0.76 cents; New York, Lake Erie and Western, 0.84 cents; Baltimore and Ohio, 0.89 cents; Central Pacific, 2.49 cents; Chicago, Burlington and Quincy, 1.11 cents; Philadelphia and Reading, 1.61 cents; Chicago and North-western, 1.47 cents; Union Pacific, 1.99 cents; Chicago, Milwaukee and St. Paul, 1.72 cents; Chicago, Rock-Island and Pacific, 1.21 cents; Wabash, St. Louis and Pacific, 0.80 cents; Michigan Central, 0.80 cents; Atchison, Topeka and Santa Fe, 2.09 cents. These fifteen roads made a freight movement equivalent to 54.86 per cent. of the number of tons of freight moved one mile by all the railway lines of the United States.

EAST AND WEST TRUNK LINES.

The most important of the reductions in rates were those made on the east and west trunk lines and their western connections, and on the granger roads. The following tables illustrate some of the most striking facts relating to diminution of charges and contemporaneous increase of traffic:—

TRUNK LINES.

Statement showing the length of its lines, earnings from freight, tons of freight moved, tons moved one mile, earnings per ton per mile, expenses per ton per mile, and net earnings per ton per mile of all freight moved on the New York Central and Hudson River Railroad from 1854 to 1884, inclusive.

Year.	Miles of railroad (all lines operating).	Earnings from freight.	Tons of freight moved.	Tons moved one mile.	Earnings per ton per mile, cts.	Expenses per ton per mile, cts.	Net earnings per ton per mile, cts.
1854...	804	$2,913,966	549,805	99,309,600	2.954	1.309	1.645
1855...	804	3,755,320	670,073	114,827,792	3.270	1.341	1.929
1856...	804	5,052,059	932,844	165,809,708	3.006	1.542	1.504
1857...	804	5,275,876	1,075,589	165,515,934	3.187	1.698	1.489
1858...	804	4,244,639	925,604	161,108,043	2 635	1.374	1.261
1859...	804	4,049,530	1,093,284	187,291,130	1.162	1.281	0 881
1860...	804	4,943,638	1,366,035	239,418,931	2.065	1.343	0.722
1861...	804	5,557,019	1,537,400	280,127,705	1.984	1.345	0.639
1862...	804	7,970,304	1,905,173	357,944,135	2.227	1.355	0.872
1863...	804	9,449,554	2,106,571	387,387,066	2.439	1.512	0.927
1864...	804	10,685,672	2,158,972	386,801,761	2.763	1.965	0.798
1865...	804	11.000,058	1,767,059	318,732 070	3 451	2.538	0.913
1866...	842	12,017,532	2,099,594	388,620,986	3.092	2.163	0.929
1867...	842	11,993,008	2,249,363	435,417,629	2 751	1.948	0.806
1868...	842	12,479,950	2,562,862	455,046,715	2.742	1.803	0.939
1869...	842	14,066,386	3,190,840	589,362,849	2 387	1 397	0.990
1870...	842	14,327,418	4,122,000	729,087,777	1.853	1.163	0 710
1871...	845	14,647,580	4,532,056	888,327,865	1.649	1 014	0.635
1872...	857	16,259,650	4,393,965	1,020,908,885	1.592	1.129	0.463
1873 ..	858	19,616,018	5,522,724	1,246,650,063	1.573	1.026	0 547
1874...	1,000	20,348,725	6,114,678	1,391,560,707	1.462	0.984	0.478
1875...	1,000	17,809,702	6,001,954	1,401,008,029	1.275	0.901	0.374
1876...	1,000	17,593,265	6,803,680	1,674,447,055	1.051	0.711	0.340
1877...	1,000	16,424,317	6,351,356	2,619,948,685	1.014	0.699	0.315
1878...	1,000	19,045,830	7,695,413	2,042,755,132	0.930	0.536	0.294
1879...	1,000	18,270,240	9,015,753	2,295,827,387	0.796	0.551	0.245
1880...	1,000	22,199,966	10,533,038	1,525,139,145	0.879	0 541	0.337
1881...	993	20,736,750	11,591,379	2,606,814,098	0 783	0.563	0.220
1882...	993	17,672,252	11,330,393	2,391,799,310	0.738	0.601	0.137
1883...	993	20,142,433	10,892,440	2,200,896,780	0.910	0.680	0.230
1884...	993	16,434,983	10,212,418	1,970,087,115	0.830	0,620	0.210

Statement showing the length of its lines, earnings from freight, tons of freight moved, tons moved one mile, earnings per ton per mile, expenses per ton per mile, and net earnings per ton per mile of all freight moved on the New York, Lake Erie and Western Railroad, from 1852 to 1884 inclusive:—

Year.	Miles of railroad operated.	Freight earnings.	Tons moved.	Ton miles.	Per ton mile. Earnings, cts.	Per ton mile. Expenses, cts.	Per ton mile. Profit, cts.
1852...	465	$1,883,198	436,460	96,697,695	1.948	1.026	0.922
1853...	498	2,537,215	631,039	101,626,522	2.496	1.277	1.219
1854...	498	3,659,590	743,250	130,808,034	2.576	1.406	1.170
1855...	498	3,653,002	843,055	150,673,997	2.424	1.155	1.269
1856...	498	4,545,722	983,221	183,458,043	2.477	1.169	1.308
1856...	498	4,097,610	978,067	165,100,850	2.457	0.897	1.560
1857...	468	3,843,310	816,964	165,895,636	2.316	0.649	1.677
1859...	559	3,195,869	869,072	147,127,039	1.621	1.344	0.277
1860...	559	3,884,343	1,139,554	214,084,396	1.814	1.001	0.813
1861...	559	4,351,464	1,253,419	251,350,127	1.771	0.929	0.843
1862...	559	6,642,915	1,632,955	351,092,285	1.892	0.956	0.936
1863...	624	8,432,234	1,815,096	403,670,861	2.088	0.964	1.124
1864...	624	9,855,088	2,170,798	422,013,644	2.335	1 456	0.879
1865...	624	10,726,264	2,234,350	388,557,213	2.761	1.984	0.777
1866...	773	11,611,023	3,242,972	478,485,772	2 427	1.654	0.773
1867...	773	11,204,689	3,484,546	549,888,422	2.038	1.472	0.566
1868...	773	10,780,976	3,908,243	595,699,225	1.809	1.339	0.470
1869...	823	10,583 794	4,312,209	817,829,190	1.539	1.171	0.368
1870...	846	11,983,547	4,852,505	898,862,718	1.333	0 975	0.358
1871...	914	12,861,999	4,844,208	897,446,728	1.442	1.013	0.390
1872...	959	14,509,745	5,564,274	950,708,902	1.527	0.979	0.548
1873...	959	15,015,807	6,312,792	2,032,986,809	1.115	0.960	0.504
1874...	959	13,740,042	6,364,276	1,047,420,238	1.311	0.913	0.398
1875...	942	12,278,399	6,239,943	1,016,618,050	1.260	0.958	0.259
1876...	957	11,429,929	5,972,818	1,040,431,921	1.098	0.885	0.213
1877...	957	10,647,807	6,182,450	1,114,586,220	0.955	0.752	0.203
1878...	928	11,914,489	6,150,463	1,224.763,718	0.973	0.674	0.299
1879...	928	12,233,481	8,212,641	1,569,222,417	0 780	0.561	0.219
1880...	952	14,391,115	8,715,892	1,721,112,095	0.836	0.534	0.302
1881...	980	15,979,577	11,086,823	1,984,394,855	0.805	0.529	0.276
1882...	1,029	14,642,128	11,895,238	1,954,389,710	9.749	0.526	0.223
1883...	1,029	15,562,141	11,965,490	1,979,448,428	0.786	0.532	0.254
1884...	1,029	12,903,157	11,071,938	1,794,946,519	0.719	0.519	0.200

Statement showing the earnings from freight, expenses of the same, tons carried one mile, average earnings per ton per mile, average expenses per ton per mile, average net earnings per ton per mile, and total tons moved on the Pennsylvania Railroad from 1855 to 1884, inclusive:—

Year.	Freight earnings.	Ton mileage.	Per ton mile. Earnings. Cents.	Per ton mile. Expenses. Cents.	Per ton mile. Net. Cents.	Total tonnage.
1855	$2,805,306	102,171,312	2 746	1.662	1.084	365,006
1856	3,244,292	119,836,501	2.707	1.662	1.045	454,092
1857	3,374,041	139,994,548	2.411	1.536	0.675	826,518
1858	3,536,206	162,121,735	2.181	1.289	0.892	1,046,899
1859	3,656,111	180,333,140	2.027	1.176	0.851	1,170,240
1860	4,191,784	214,162,018	1.957	1.176	0.781	1,346,525
1861	5,398,026	280,262,522	1.926	0 912	1.014	1,482,087
1862	7,668,420	376,195,127	2.038	1.077	0.961	2,058,548
1863	8,602,262	393,746,258	2.185	1.147	1.038	2,265,413

Year.	Freight earnings.	Ton mileage.	Per ton mile. Earnings. Cents.	Expenses. Cents.	Net. Cents.	Total tonnage.
1864	10,361,999	420,627,222	2.463	1.871	0.592	2,585,379
1865	11,193,565	420,060,260	2.665	2.281	0.384	2,555,706
1866	11,709,294	513,102,181	2.282	1.821	0.461	3,186,359
1867	11,832,300	565,657,813	2.092	1.514	0.548	3,709,224
1868	12,882,165	675,775,560	1.906	1 249	0.657	4,427,884
1869	12,932,657	752,711,312	1.718	1.200	0.518	4,991,995
1870	12,793,160	825,979,692	1.549	0.998	0.551	5,427,401
1871	14,052,305	1,011,892,207	1.389	0.874	0.515	6,575,843
1872	16,856,891	1,190,144,036	1.416	0.886	0.530	7,844,778
1873	19,608,555	1,384,831,970	1.416	0.857	0.559	9,211,234
1874	17,227,505	1,372,566,976	1.255	0.748	0.507	8,626,946
1875	15,651,741	1,479,414,466	1.058	0.616	0.442	9,115,368
1876	14,539,784	1,629,742,021	0.892	0.582	0.310	9,922,911
1877	14,642,109	1,494,798,198	0.980	0.552	0.428	9,738,295
1878	15,904,501	1,732,003,131	0 918	0.483	0 435	10,946,752
1879	17,016,989	2,136,708,887	0.796	0 427	0 369	13,684,041
1880	20,234,046	2,298,317,323	0.880	0.474	0.406	15,364,788
1881	22,400,120	2,655,438,764	0.799	0 437	0 362	18,229,365
1882	23,517,178	2,879,542,701	0 817	0 473	0.344	20,360,399
1883	24,[illegible]36,789	2,996,892.567	0.819	0 477	0.342	21,674,160
1884	22,823,329	3,082,499,986	0.740	0.441	0.299	22,583,825

REDUCTION OF FREIGHT RATES ON THE PENNSYLVANIA RAILROAD DIVISION.

The table published below shows rapid growth of traffic, marvelous reduction of rates, and immense sums saved to shippers and consumers by these reductions. It will be seen that on the Pennsylvania Railroad division the total number of tons moved one mile in 1865 was 420,060,260; that the average rate per ton per mile received during that year was 2.665 cents; and that the aggregate saving or reduction on the total quantities moved from 1866 to 1882, inclusive, in comparison with the charges made in 1865, reached the large aggregate of $382,947,486.26. The table or statement is as follows:—

Statement showing, for each year from 1865 to 1882, inclusive, on the Pennsylvania Railroad division, the number of tons of freight moved one mile, the rate per ton per mile, and the amount of reduction in any given year, computed on the difference between the rate in that year and that which was charged in 1865:—

Years.	Total tons one mile.	Average rate per ton per mile.	Amount of reduction each year computed on rate of 1865.
1865	420,060,260	2.665	$..........
1866	513,102,181	2.282	1,965,181 35
1867	565,657,813	2.092	3,241,219 27
1868	675,775,560	1.906	5,129,136 50
1869	752,711,312	1.718	7,128,176 12
1870	825,979,692	1.549	9,217,933 36
1871	1,011,892,207	1 389	12,911,744 56
1872	1,190,144,036	1.416	14,864,899 01
1873	1,384,831,970	1.416	17,296,551 31
1874	1,372,566,976	1.255	19,353,194 36
1875	1,479,414,466	1.058	23,774,190 47
1876	1,629,742,021	0.892	28,895,326 03
1877	1,494,798,198	0.980	25,187,349 61
1878	1,732,003,131	0.918	39,258,094 70
1879	2,136,708,887	0.796	39,935,088 91
1880	2,298,317,323	0.880	41,024,964 22
1881	2,655,438,764	0.799	49,550,487 34
1882	2,879,542,701	0.817	53,213,949 11
Total reduction for 17 years			$382,947,486 26

The table also presents facts worthy of careful consideration in its statement of the total number of tons moved one mile during each year. The main portion of this movement was of business originating in Pennsylvania, and the growth of traffic, therefore, reflects the rapid advance of various forms of industrial development. Many mines are opened, many manufactories established and enlarged, many forests cut down and converted into furniture or building material, and many other forms of industry are vitalized, mainly on account of the opportunities for reaching profitable markets which are furnished by cheap transportation. The fact that the number of tons moved one mile increased from 420,060,260 in 1865 to 2,879,542,701 in 1882 is a fair indication that the volume of business transacted by the shippers increased nearly seven-fold in seventeen years.

The most potent cause of the rapid industrial advancement which characterizes the age is, indeed, the extraordinary cheapness of modern rail transportation. Few persons realize the full force of the contrasts between present and former methods of moving freight. The average rates on the Pennsylvania Railroad division represent less than the sums formerly charged by turnpike companies for the privilege of hauling Conestoga wagons over the improved roads they constructed, while for many wagon movements the rate of from twenty to thirty cents per ton mile, and during unfavorable seasons much higher rates, were often charged. Before the era of canals and railways many forms of production were stifled by the enormous cost of overland transportation.

An indication of the contrasts between the railway charges of the present day and such extensive wagon movements as are still made is furnished by a statement published in the St. Paul Pioneer Press, of March 2d, 1883, of bids for the wagon freighting of United States government stores on routes in Minnesota and Dakota, which were opened by the United States quartermaster at St. Paul on March 1st, 1883. The lowest rate per 100 pounds per 100 miles was $1.40, and the highest rate was $3.43. At the first of these rates the movement of a ton of 2,000 pounds over 100 miles would cost $28, and the average rate be 28 cents per ton per mile. At the highest of the bids made the cost of moving a ton of 2,000 pounds 100 miles would be $68.60, or at the average rate of $68\frac{6}{10}$ cents per ton per mile. By the reduction from such figures (which formerly prevailed even in Pennsylvania) to the present rail rates many existing industries have been created and immensely expanded.

REDUCTION OF RATES IN OHIO

The following table, of the business reported by all roads passing through the state of Ohio, shows clearly the increase in amounts carried and the decreased cost of transportation:—

Year.	Tons freight, one mile.	Average rate per ton per mile, cents.
1869	1,332,307,931	2.446
1870	1,673,017,568	1.993
1871	1,773,983,405	2.215
1872	2,923,292,084	1 569
1873	3,420,889,453	1.566
1874	3,717,622,979	1.344
1875	3,431,745,707	1.259
1876	3,799,397,649	1.117
1877	4,146,926,306	.933
1878	4,286,378,592	.961
1879	4,914,503,869	.815
1880	6,655,562,182	.895
1881	7,607,215,616	.915

The following table shows the tons of freight moved one mile in Ohio alone, from 1869 to 1881, inclusive, also the amount saved to shippers thereby, compared with the amount of taxes of all kinds in the state during that time. From this table it will be seen that by the decline of rates since 1869 there has been saved to those who are charged with the cost of shipping the sum of $337,674,755.99, an amount exceeding the local taxes paid during that period by $21,707,759.66.

Year.	Tons, one mile in Ohio.	Rate per per ton per mile.	Decrease from 1869, per cent.	Amount saved.	Total taxes in Ohio.
1869	739,031,209.33	2.446	...	....	....
1870	898,410,433.02	1.993	.453	$4,073,899 26	$23,463,631 82
1871	938,259,822.90	2 215	.231	2,167,380 19	22,955,388 40
1872	1,494,094,584.13	1.569	.877	13,103,209 50	23,810,971 97
1873	1,941,012,675.53	1.566	.880	17,080,911 54	26,131,353 28
1874	2,147,299,032.67	1.334	1.112	23,877,965 24	26,837,196 77
1875	1,917,659,501.07	1.259	1.187	22,762,618 28	27,952,971 37
1876	2,117,024,370.02	1.117	1.329	28,135,253 88	28,521,256 52
1877	2,360,015,760.74	.933	1.513	35,707,038 46	27,514,650 79
1878	2,493,815,064.83	.961	1.485	37,033,153 71	26,324,445 30
1879	2,741,310,258.11	.815	1.631	44,710,770 31	25,756,665 61
1880	3,393,814,541.62	.895	1.551	52,638,063 54	29,092,084 27
1881	3,681,892,358.14	.915	1.531	56,384,591 08	27,606,380 29
				$337,674,755 99	$315,966,996 83

WESTERN TRUNK-LINE CONNECTIONS.

Statement showing the number of miles operated, the total tonnage moved, the number of tons moved one mile, earnings from freight, the earnings, costs, and profit per ton per mile of moving freight over the Pittsburgh, Fort Wayne and Chicago Railway from 1857 to 1884, inclusive:—

Year.	Miles opened.	Tons moved.	Moved one mile.	Freight earnings.	Earnings per ton per mile.	Expenses per ton per mile.	Profits per ton per mile.
	Miles.	Tons.	Ton-miles.		Cents.	Cents.	Cents.
1857	383.0	304,769	28,893,960	$657,686	2.27	.57	0.70
1858	384.0	285,663	35,168,323	667,296	1.90	1.32	0 58
1859	365.0	362,606	58,421,205	964,133	1.65	1.18	0.47
1860	468.3	465,204	78,423,319	1,309,714	1.67	1.18	0.49
1861	468.3	526,379	111,398,984	1,905,707	1.71	0.98	0.73
1862	468.3	643,107	126,046,905	2,401,630	1.90	0.98	0.92
1863	468.3	805,525	166,570,631	3,341,034	2.01	1.20	0.81
1864	468.3	858,928	174,621,870	4,148,504	2.38	1.50	0.88
1865	468.3	832,615	193,789,901	4,739,068	2.44	1.79	0.65
1866	468.3	1,025,778	233,274,794	4,707,582	2.02	1.50	0.52
1867	468.3	1,154,351	228,791,443	4,483,616	1.95	1.44	0.51
1868	468.3	1,509,052	307,443,978	5,231,857	1.70	1.15	0.55
1869	468.3	1,665,190	309,521,917	5,020,874	1.62	1.11	0.51
1870	468.3	1,740,585	336,084,380	4,892,325	1.45	0.86	0.59
1871	468.3	2,047,114	391,035,801	5,581,051	1.43	0.78	0.65
1872	468.3	2,407,018	487,852,472	6,909,306	1.40	0.81	0.59
1873	468.3	2,292,644	479,917,429	6,716,399	1.40	0.95	0.45
1874	468.3	2,309,128	461,696,190	5,841,961	1.26	0.74	0.52
1875	468.4	2,496,148	491,289,899	5,430,511	1.11	0.69	0.42
1876	468.3	2,604,767	563,400,267	5,266,172	0.93	0.63	0.30
1877	468.3	1,690,735	439,998,381	4,790,424	1.01	0.67	0.34
1878	468.3	3,026,250	637,470,506	5,600,458	0.88	0.50	0.38
1879	468.3	3,679,382	803,083,260	6,066,594	0 76	0.44	0.32
1880	468.3	3,865,675	806,257,399	7,359,452	0.91	0 51	0.40
1881	468.3	4,753,220	1,044,447,161	7,785,730	0.75	0 43	0.32
1882	468.3	4,837,236	991,937,501	7,464,057	0.75	0.47	0.28
1883	467.6	5,076,311	944,563,376	7,432,479	0 79	0 55	0.24
1884	467.9	4,696,583	907,954,237	6,111,216	0.67	0.49	0.18

Freight Movements on the Lake Shore and Michigan Southern.

Year.	Tons.	Tons one mile.	Revenue.	Receipts per ton per mile. Cents.	Cost per ton per mile. Cents.	Profit per ton per mile. Cents.
1870	2,978,725	574,035,571	$8,746,126	1.504	.932	.572
1871	3,784,525	733,670,696	10,341,218	1.391	.913	.478
1872	4,443,092	924,844,140	12,824,862	1 374	.920	.454
1873	5,176,661	1,043,957,189	14,192,399	1.335	.946	.389
1874	5,221,267	999,342,081	11,918,350	1.180	.767	.413
1875	5,022,490	943,236,161	9,639,038	1.010	.737	.273
1876	5,635,167	1,133,834,828	9,405,629	.817	.561	.256
1877	5,513,398	1,080,005,561	9,476,608	.864	.573	.291
1878	6,098,445	1,340,467,821	10,048,952	.734	.474	.260
1879	7,541,294	1,733,423,440	11,238,261	.642	.398	.244
1880	8,350,336	1,851,166,018	......	.750	....	.315
1881	9,164,508	2,021,775,468	......	.617	....	.203
1882	9,195,538	1,892,868,224	......	.628	....	.215

Freight Movements on the New York, Pennsylvania and Ohio.

Year.	Millions of ton miles. Local.	Through.	Total.	Cents per mile.	Freight earnings.
1872	154.3	101.2	255.5	1.496	$3,924,078
1873	136.9	140 0	276.9	1.450	4,016,539
1874	148.5	156.5	305.0	1.186	3,617,524
1875	132.4	167.0	299.4	0.981	2,938,204
1876	114.1	174.3	288.4	0.905	2,611,117
1877	77.0	260.4	337.4	0.903	3,066,408
1878	80.9	249.8	330.7	0 835	2,764,781
1879	120 6	354.2	474.8	0.697	3,310,284
1880	117.4	356.9	474.3	0.831	3,945,494
1881	125.0	484.5	609.5	0 665	4,057,264
1882	118.1	576.0	694.1	0 621	4,315,028

COMBINED OPERATIONS OF TRUNK LINES AND THEIR WESTERN CONNECTIONS.

Statement of through charges per ton per mile on grain and fourth-class freight from Chicago to New York, all rail, 963 miles, via Michigan Central and connecting roads.

(Prepared for Senate committee on transportation by H. E. Sargent, general superintendent Michigan Central Railroad.)

Date.	Through rate per 100 pounds.	Rate per ton per mile.
1871.—January 1st to March 5th	65	1.35
March 6th to March 8th	60	1.25
March 9th to March 18th	55	1.14
March 19th to June 13th	45	.935
1871.—June 14th to July 22d	40	.831
July 23d to August 11th	45	.935
August 11th to September 28th	50	1.04
September 29th to October 6th	55	1.14
October 7th to October 28th	60	1.25
October 29th to December 31st	65	1.35
1872.—January 1st to March 26th	65	1.35
March 27th to April 4th	60	1.25
April 5th to May 1st	55	1.14
May 2d to May 18th	50	1.04
May 19th to September 3d	45	.935
September 4th to September 11th	50	1.04
September 12th to September 17th	55	1.14
September 18th to October 17th	60	1.25
October 18th to December 31st	65	1.35
1873.—January 1st to April 15th	65	1.35
April 16th to April 22d	60	1.25
April 23d to April 28th	55	1.14
April 29th to May 20th	50	1.04
May 21st to September 5th	45	.935
September 6th to September 15th	50	1.04
September 16th to November 12th	55	1.14

REDUCTIONS IN RATES BETWEEN INDIANAPOLIS AND NEW YORK CITY.

Another method of presenting the subject is furnished in the following extract from an article published in the Indianapolis Journal in August, 1883. Its illustrations of reductions in rates to and from Indianapolis rather falls below than exceeds the standard applicable to many other places:—

"In the year 1863 the rate on grain from Indianapolis to New York was 75 cents per 100 pounds; on flour $1.50 per barrel. In 1869 the rate was reduced on grain to 60 cents per 100 pounds and $1.20 per barrel for flour. The rate now is 23 cents per 100 pounds on grain and 48 cents per barrel for flour. The general manager of a fast freight line yesterday remarked to the Journal reporter that in 1869 he contracted with an Indianapolis miller to forward all the flour he turned out for a period of 90 days at $1 per barrel. The trunk-line management at first refused to carry out the contract, but afterwards consented to do so, but gave said agent to understand that his services would not be needed if he again made a similar cut on tariff rates. The same line is now hauling flour at 46 cents per barrel from Indianapolis to New York, and rather than miss a shipment would doubtless shade that rate. But in west-bound business the reduction in tariff rates has been even more marked. In 1863 the rate on first-class freights from New York to Indianapolis was $1.98 per 100 pounds; in 1869 it was reduced to $1.66; in 1880 to $1.11½, and the rate is now 71 cents per 100 pounds. In 1868 one of the trunk lines gave a $1.10 per 100 pounds rate on first-class freight, which created a great rumpus in railroad circles, and was dropped by competing roads only on the promise that such a rate would never again be offered. Formerly a car run from New York to Indianapolis earned from $400 to $600; now if a car earns $125 to $150 it is spoken of as big earnings."

EAST-BOUND RATES FROM ST. LOUIS IN DECEMBER, 1882.

In the tariff sheet for east-bound freights, dating from December 1st, 1882, issued in accordance with the resolution of the joint executive committee, the only material changes were in the eighth, ninth, and tenth classes, with special rates for flour and dressed beef in car-load lots. The rate on all classes applies from East St. Louis, and on dressed-beef shipments are quoted as follows in car lots: Hartford, Portland, Providence, Boston, New Haven, Bridgeport, and Worcester, 74 cents; New York and Montreal, 74 cents; Philadelphia, 72 cents; Baltimore, 71 cents; Albany, Troy, and Schenectady, 71 cents; Buffalo, Toronto, Suspension Bridge, Salamanca, Dunkirk, Pittsburgh, and Wheeling, 40 cents. The basis of rates is as follows from Chicago to New York: First class, $1; second, 85 cents; third, 70 cents; fourth, 60 cents; fifth, 50 cents; sixth, 45 cents; seventh, 35 cents; eighth, 30 cents; ninth, 40 cents; tenth, 35 cents; flour, 60 cents, and dressed beef, 64 cents.

GRANGER ROADS AND WESTERN CONNECTIONS OF THE TRUNK LINES

Statement of the combined freight operations of the following roads leading in eastern and western directions from Chicago, viz: Chicago and Alton; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago and North-western; Chicago and Rock Island; Illinois Central; Lake Shore and Michigan Southern, and Michigan Central:—

Year.	Aggregate gross earnings from f.eight.	Aggregate tons of freight carried.	Aggregate number of tons moved one mile.	Rate in cts. per ton per mile.
1870	$42,290,522	12,303,084	1,899,320,549	2.227
1871	44,363,029	14,282,025	2,183,478,482	2.032
1872	47,297,976	16,273,819	2,512,960,724	1 882
1873	55,675,118	19,321,854	3,070,824,967	1.813
1874	57,667,217	20,234,482	3,169,033 910	1.820
1875	51,755,867	20,371,512	3,244,167,960	1.596
1876	51,014,221	22,179,757	3,602,384,890	1.416
1877	50,292,343	21,708,119	3,781,864,513	1.330
1878	56,361,357	24,560,317	4,691,407,423	1.202
1879	61,685,868	29,862,069	6,326,175,549	0.975
1880	77,824,956	36,363,790	7,134,247,668	1.090
1881	81,343,483	40,537,451	7,247,000,493	1.122
1882	86,241,382	42,961,275	7,637,439,578	1.129
1883	97,517,203	45,339,862	8,598,968,708	1.134
1884	91,332,999	45,080,803	8,529,849,513	1.071

The report on internal commerce of the United States Statistical Bureau for 1879 says:—

"The following table shows the average annual freight charges per ton per mile on several of the most important trunk lines of the country from the year 1868 to the year 1878, inclusive:—

Statement showing the average annual freight charges per ton per mile on several transportation lines engaged in commerce between the Western states and the Atlantic seaboard from 1868 to 1878, inclusive:—

Lines.	1868. Cents.	1869. Cents.	1870. Cents.	1871. Cents.	1872. Cents.	1873. Cents.	1874. Cents.	1875. Cents.	1876. Cents.	1877. Cents.	1878. Cents.
New York canals (freight and tolls)	.872	.924	.835	1.027	1.016	.887	.743	.668	.679	.564	.420
New York Central Railroad	2 743	2 387	1.884	1.649	1.593	1.573	1.462	1.275	1.051	1 014	.914
Erie (N. Y., Lake Erie and Western) Railroad	1.81	1.539	1.333	1.433	1.526	1.454	1.312	1.209	1.099	.955	.973
Pennsylvania Railroad	1.906	1.718	1.549	1.389	1.416	1.416	1.255	1 058	.892	.980	.918
Boston and Albany Railroad	2.811	2.435	2.193	2 09	2.016	1.958	1.818	1.533	1.288	1.208	1.129
Philadelphia and Erie Railroad	1.609	1.433	1 303	1 205	1.192	1.135	.977	.865	.776	.786	.728
Lake Shore and Michigan Southern Railroad	2.336	1.714	1.504	1.391	1.374	1.335	1.18	1.01	.817	.864	.734
Michigan Central Railroad	2.45	2.09	1.982	1.747	1.867	1.891	1.569	1.398	1.115	.878	.848
Chicago, Burlington and Quincy Railroad	3.248	3.063	2.392	2.2	2.076	1.921	1.901	1.889	1.603	1.428	1.247
Chicago and North-western Railroad	3.168	....	3.093	2.869	2.614	2 351	2.226	1.946	1.789	1.702	1.724

N. B.—The fiscal year of the railroads nearest to the several calendar years are given in the above table.

The foregoing table indicates that there has been a large falling off in the average annual freight charges on all the transportation lines mentioned. Without taking in account the tonnage transported on the different lines, it appears that the average earnings per ton per mile of the several transportation lines fell from about 2.295 cents during the year 1868 to .954 cent during the year 1878, or less than half the average rate of the former year. The effect of the reduction of freight charges on the railroads of the country is illustrated by the fact stated in Poor's Railroad Manual for 1879 that 'had the rates of 1873 on the New York Central and Hudson River Railroad been maintained, the freight earnings of that road, during the past year, would have equaled $31,000,000 in place of $19,045,830, the amount actually received.'

Until about the year 1870 it was the opinion generally entertained by the managers of the east and west trunk lines that they could not profitably engage in the transportation of grain from Chicago to New York at a lower rate than about 40 cents per hundred pounds, or 24 cents per bushel on wheat. But during the year 1878 the average rate for the carriage of wheat from Chicago to New York was, by lake and canal, somewhat under 10 cents per bushel, and by all rail only 16½ cents per bushel. During the present season of 1879 grain has been shipped from Chicago to Liverpool for 17 cents a bushel, a rate but little greater than that which prevailed for the transportation of grain from Buffalo to New York by canal and Hudson river only ten years ago."

PRACTICAL RESULTS OF THE LOW RATES FOR MOVEMENTS BETWEEN THE ATLANTIC SEABOARD AND THE MISSISSIPPI VALLEY.

The practical results of the low rates for movements between the Atlantic seaboard and the Mississippi valley embrace not only the attainment of an object of great national and international importance, viz., the extensive movement of breadstuffs and provisions and large exportations of food products, but an innumerable array of incidental advantages, the nature of which is indicated by the following extract from a newspaper article published a few years ago, showing the relatively slight burden which the low freight charge imposes on consumers:—

"A barrel of the best flour, worth in New York $7, will make 180 loaves of bread; cost of making the loaves is $3; whole cost $10; retailer's price for the 180 loaves, at 10 cents a loaf, $18; profit, $8. The total freight charge on a barrel of flour from Minneapolis to New York is $1, or about ½ cent for the flour of one loaf.

A hindquarter of beef, weighing 200 pounds, costs in New York, at 9 cents per pound, $18; retails at 16 cents per pound, or $32 for the whole quarter; profit, $14. The railroads carry dressed beef from Chicago to New York for 40 cents per 100 pounds, or 4 mills per pound. Hams and bacon, on which the consumer pays a profit of 4 or 5 cents per pound, are carried by the railroads from St. Louis, Cincinnati, and Chicago to New York for ⅓ of a cent per pound.

The consumer in states west of the Mississippi pays an average price of, say, 90 cents per pound for tea, an average profit of 40 cents. Tea is first-class freight. The freight charges for 100 pounds of tea from New York to Davenport, Des Moines, Council Bluffs, Kansas City, and St. Paul—from 1,200 to 1,500 miles—range at the average from 90 cents to $1.10; an average of a cent per pound. Tea may suffice as an example for other food articles and food products. Whenever the consumer pays a high margin of profit over the producer's price, as in coffee, canned goods, fruits, and other groceries, he does not pay it to the transporter, but to the middlemen and dealers.

A suit of clothes may be bought by the working man or average citizen for from $20 to $30. The transporter's charge from eastern manufactories to points west of the Mississippi does not exceed an average of five cents on a suit of clothes. The average profit to dealers on a $20 suit of clothes is $8 The profit on a single pair of $4 boots or shoes is three times the total freight charges on a dozen pairs 1,500 miles."

FREIGHT REDUCTIONS ON VARIOUS CLASSES OF ROADS.

A VARIETY of statistics, illustrating the tendency towards a reduction in average rates already shown, might be compiled from the annual reports of all classes of roads that participated actively in competitive traffic, or that rapidly increased to large proportions the amount of their local freight traffic. These reductions are such important factors in everything relating to internal commerce that they cannot be too deeply impressed upon the minds of those who wish to know what the American railroad systems are and what they do. At the same time, when traffic is light it is impossible to earn interest on the cost of the railways of any locality unless relatively high charges are imposed.

Another great element of cheapness is the length of the lines over which movements are made. Short roads cannot work as cheaply as long ones. An illustration of this principle is furnished by the following statement, made by Henry C. Carey in the Pennsylvania constitutional convention of 1873:—

"From the first mile on a railroad to the last there is a perpetual diminution of rate. On the Reading railroad it commences with 10 cents per mile for 5 miles, falling to 2.60 at 50, and terminating with a little more than 2 at 90 or 93 miles. . . . On the Pennsylvania Central road the charge for a barrel of flour for the first 10 miles is a cent a mile. At 50 miles it becomes two-fifths of a cent, and at Pittsbugh one-fifth of a cent."

In some of the statements published to illustrate reductions of rates methods have been adopted by the compilers which may lead to erroneous conclusions. For instance, if there are five railways in a state, and their average rates per ton per mile are respectively 2, 4, 6, 8, and 10 cents, and the average freight rate of the state is deduced from a calculation based on the sum total of these rates divided by the number of lines, the result will be one-fifth of thirty cents, or six cents per ton per mile. It may happen, however, that the traffic of the state is so distributed that the bulk of all the railway freight movements made in it are conducted over the line that charges only an average rate of two cents per ton per mile, in which case the average charges actually imposed would probably be not more than three cents, or one-half the sum reached by the other method of calculation.

RATES ON NEW ENGLAND ROADS.

The average freight charges on all the railways of New England in 1879–80 is stated in the census report on railways to be 1.83 cents per ton per mile.

The report of the Massachusetts railway commission, dated January, 1887, contains the following table of the average rates of freight, in 1865 and 1886, of the lines named:—

	Rate, 1865. Cents.	Rate, 1886. Cents.	Per cent. of 1865 and 1866.
Boston and Albany	3.90	1.10	28
Boston and Maine	4.58	2.27	49
Boston and Providence	4.38	2.84	65
Connecticut River	6.20	2.81	45
Fitchburg	4.10	1.07	26
Old Colony	3.20	2.93	92

The average freight charges per ton per mile, on the lines named below, for the six years ending with 1886, are shown in the following table:—

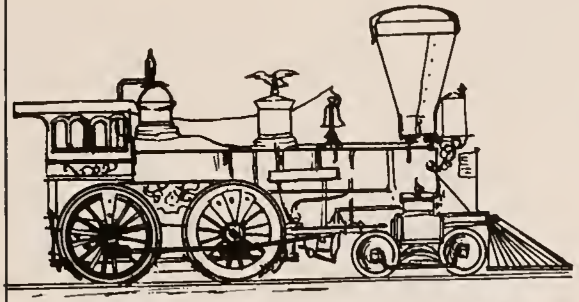
	Freights.					
	1881. Cts.	1882. Cts.	1883. Cts.	1884. Cts.	1885. Cts.	1886. Cts.
Boston and Albany	1.04	1 07	1.20	1 09	0.94	1.10
Boston and Maine	2.43	2.35	2.24	2.34	2.13	2 27
Boston and Providence	2 77	2.83	2.83	2 82	2.83	2.84
Old Colony	2.99	3.04	3.16	3.00	2.90	2.93
Boston and Lowell	3.13	2.60	2.98	2.33	1.77	1 67
Fitchburg	1.26	1.18	1.19	1.09	1.06	1.07
Eastern	2.06	2.03	1.92	1.81	...	...
New York and New England	2.20	1.77	1.38	1.41	1.71	1.67
Connecticut River	2.99	3.07	3.04	3.05	2.96	2.81
New York, New Haven and Hartford	1.79	1.98	1.89	1.96	1.96	2.00
Providence and Worcester	2.80	2.78	2.96	3.09	2.45	2.49

ANTHRACITE AND BITUMINOUS COAL ROADS.

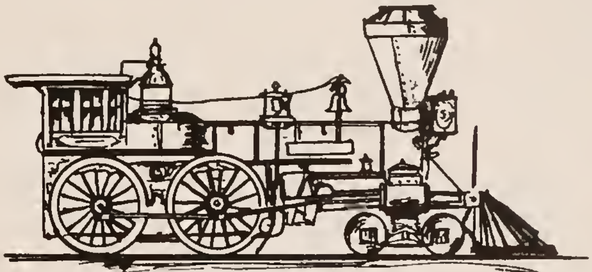
The position of a large number of anthracite and bituminous coal roads in the matter of freight charges is peculiar, as much of the coal they transport is mined by companies in which they are interested, or the principal or sole owners. They also, however, transport a great deal of coal which is mined by individual operators or by corporations in which they have no direct interest. In the aggregate, the coal freight movements of all kinds and of all qualities form the largest made in the country. In the numerous cases where the principal railway carrier is directly or indirectly the principal miner or mining operator of the coal carried the amount of remuneration actually received depends upon the price obtained for the coal sold. When coal is selling at low figures there is either small profit or an absolute loss on the entire transaction of mining, carrying to market, and selling coal, and it is a matter of comparatively little real consequence whether the apparent burden of the loss or lack of profitable results is thrown upon the accounts of the collieries owned and operated or upon the railroad by reductions in rates of transportation. In practice, however, the nominal railway rates for carrying anthracite have usually been well maintained, on account of the large amount of coal carried for individual operators, but in years when the trade was not in a flourishing condition the sums actually received by the heavy anthracite coal carriers for coal usually represent either a notable reduction of the nominal transportation rates or a considerable loss at the collieries in which they were interested. Much of the bituminous coal has frequently, and of late years generally, been carried to market at exceedingly low rates, probably the lowest ever given for movements of equal magnitude, as they often represented only a small fraction of a cent per ton per mile. The rates published, officially reported, and paid by individual operators, should be construed in the light of the statements made above, and some allowance should also be made for drawbacks of various kinds and for various reasons, which form a prominent feature of some of the coal freight tariffs. Allowance should also be made for the fact that usually the cars that carry coal to market are sent back to the mines empty, on account of the obvious difficulty of obtaining a sufficient amount of back-loading and the character of the cars used.

The reported charges in Pennsylvania, in which state nearly all the anthracite traffic and a large proportion of the semi-bituminous and bituminous traffic of the entire country, originates, in 1875 and 1882, were as follows:—

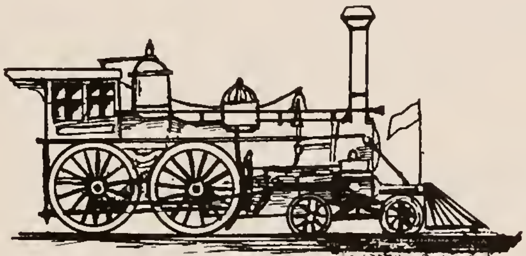
	1875. Per ton per mile. Cents.	1882. Per ton per mile. Cents.
Anthracite Coal Chiefly.		
Philadelphia and Reading, proximate average per ton of 2,240 pounds	1.85	1.51
Delaware, Lackawanna and Western, through coal	1.78	1.09
" " " local coal	2.00	.89
Lehigh Valley, through and local, per ton of 2,000 pounds	1 46	1.27
Delaware and Hudson Canal, through coal	1.50	1 to 1½
" " local coal	2.00	...
Lehigh and Susquehanna, through coal	1.60	1.17
" " " local coal	1.60	1.17
Northern Central	1 425	...
Pennsylvania and New York Canal and Railroad Co.	1.68	...
Erie, local coal	1.26	...
Atlantic and Great Western, through coal	1 to 1½	...
" " " local coal	1½ to 3	...
North Pennsylvania, through coal	1.80	...
" " local coal	2.66	...
Bituminous or Semi-Bituminous Coal Chiefly.		
Bell's Gap, through coal	6.00	2.13
" local coal	9.5	5.00
Buffalo, New York and Philadelphia, through coal	1.25	.75
" " " " local coal	1.75	1.00



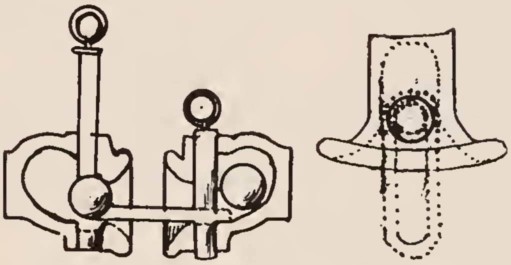
Danforth, Cooke & Co. Locomotive.



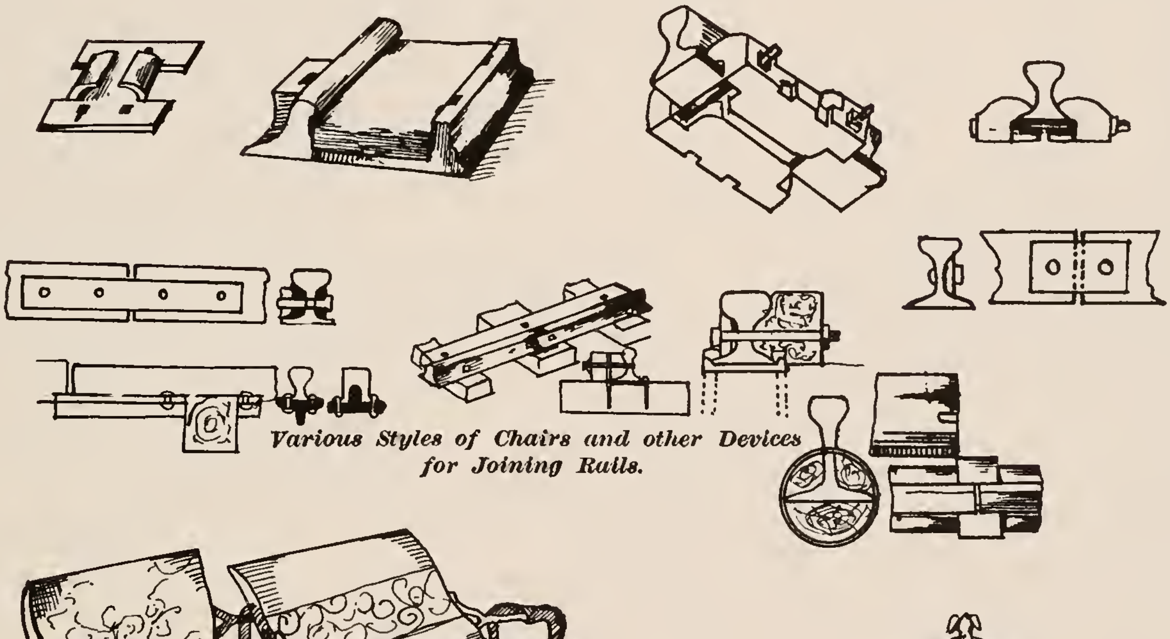
Jersey City Works Locomotive.



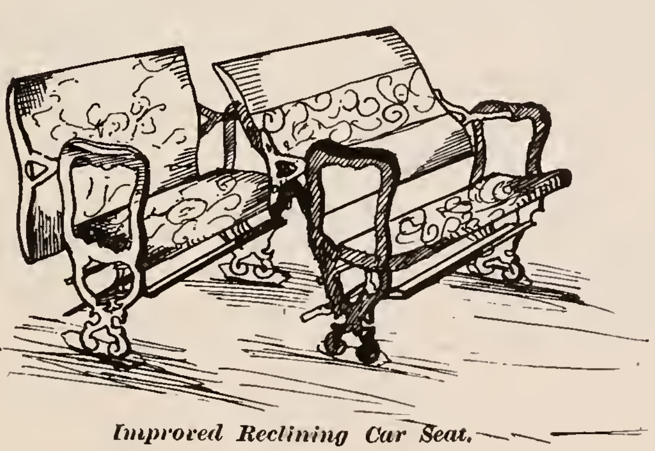
Boardman Coal-Burning Locomotive.



Patent Self-acting Car-Coupling.



Various Styles of Chairs and other Devices for Joining Rails.



Improved Reclining Car Seat.

Coal-Burning Car Stove.

RAILWAY APPLIANCES OF 1857.

	1875. Per ton per mile. Cents.	1882. Per ton per mile. Cents.
Corning, Cowanesque and Antrim, through coal	1.50	...
" " " " local coal	5.00	4.00
Dunkirk, Allegheny Valley and Pittsb., through coal	1.00	.75
" " " " local coal	1.25	1.00
Erie and Pittsburgh, through coal	...	1.120
" " local coal	1 60	1 120
Huntingdon and Broad Top Mountain, through coal	1½	1 00
" " " " local coal	2⅜	2 00
Lake Shore and Michigan Southern, local coal	1.20	.698
Oil Creek and Allegheny River, through coal	1.10	...
" " " " local coal	3.25	...
Pittsburgh and Connellsville, through coal	1.17	.70
" " " local coal	1.86	1.50
Shenango and Allegheny, through coal	1½ to 2	...
Tioga, through coal	2.50	2.00
" local coal	5.00	3.00

SOUTHERN RAILWAY RATES.

General Herman Haupt, in October, 1873, when manager of a line from Atlanta to Richmond, including the North Carolina Railroad, testified to Senate committee on transportation routes to the seaboard that the company had offered to carry iron ore as low as a cent and a half per ton per mile, and that for distribution to local consumers the lowest charge was 3½ to 4 cents per ton per mile, and that through freights were entirely governed by competition. Other portions of his testimony were as follows:—

Q. What is the general price for carrying passengers in the south?

A. About 4 or 5 cents per passenger per mile for local, and about 3 cents for through.

Q. Why is it so much greater in the south than in the north?

A. In consequence of the very sparse population, and the inability to meet expenses even at those rates, and because the business is not large enough to justify a reduction, and could not be materially increased thereby. The population is limited, and not of such a character that there would be an increase of travel consequent upon the reduction of rates. It is not expedient, or indeed practicable, to reduce them. Very few of the roads in the south are earning more than enough to pay operating expenses, and a large proportion of them do not pay the interest on their debts.

Q. What is the general rate of freight per ton per mile as compared with northern roads?

A. Very much higher. The average on most of the southern roads will run from 4 to 5 cents per ton per mile for local freights, while on the northern roads, the Pennsylvania Railroad particularly, the same class of freight would be carried for less than 2 cents per ton per mile.

Q. Is it double then in the south?

A. I should think that would be a fair estimate.

Q. What reason do you give for that?

A. The small amount of business and the necessity for charging higher rates in consequence. For example, the Richmond and Danville road carries 100,000 tons. The Pennsylvania road carries 8,000,000 tons.

The Louisville and Nashville report for 1878–79 contained the following statement:—

	Average cost per ton-mile of freight. Cents.	Average revenue per ton-mile of freight. Cents.
1872–73	1.66	2.25
1873–74	1.47	2 15
1874–75	1.23	1.92
1875–76	1.08	1.85
1876–77	.96	1.765
1877–78	.95	1.714
1878–79	.89	1.564

The following table was furnished by the Chamber of Commerce of Atlanta in November, 1873, to the Senate committee on transportation to the seaboard:—

Freight Charges, Green Line Rates, September 15th, 1872.

From St. Louis to Atlanta, Ga.:—	Per 100 pounds.	Per ton.
Coal	63 cents.	$12 60
Cotton	84 cents.	16 80
Furniture	$4 20	84 00
Lime	63 cents.	12 60
Lumber	63 cents.	12 60
Iron, scrap and pig	1½ cents per ton per mile.	10 24
Iron manufactures and machinery	63 cents to $1 40	12 60 to 28
Salt	63 cents.	12 60
Slate	No rates.	No rates.
Iron, railroad	1½ cents per ton per mile.	10 24
From St. Louis to Savannah:—		
Coal	70 cents.	14 00
Cotton	75 cents.	15 00
Furniture	$4 20	84 00
Lime	70 cents.	14 00
Lumber	70 cents.	14 00
Iron, pig and scrap	1½ cents per ton per mile.	14 40
Iron manufactures and machinery	70 cents to $1 40	14 00 to 28
Salt	70 cents.	14 00
Slate	No rates.	No rates.
Railroad iron	1½ cents per ton per mile.	14 40

An argument made by Mr. E. P. Alexander before the Senate railroad committee of Georgia at Atlanta, Ga., on September 22d, 1879, contained the following:—

Comparison of Cotton Rates in 1875 and 1879.

From—	Year.	Per 100 pounds to— Charleston or Savannah.	New York	Boston.
Atlanta	1875	60	$1 10	$1 20
"	1879	45	70	75
Decrease		15	40	45
Buckhead	1875	74	$1 24	$1 39
"	1879	60	90	95
Decrease		14	34	44
La Grange	1875	80	$1 30	$1 40
"	1879	60	85	90
Decrease		20	45	50

Comparison of Merchandise Rates in 1875 and 1879.

New York to	Year.	Classes per 100 pounds. 1.	2.	3.	4.	5.	6.
Atlanta	1875	$1 70	$1 40	$1 10	90	80	70
"	1879	1 25	1 10	85	75	60	45
Decrease		45	30	25	15	20	25
Buckhead	1875	$1 73	$1 58	$1 43	$1 28	$1 18	$1 08
"	1879	1 46	1 26	1 07	91	75	55
Decrease		27	32	36	37	43	53

On nearly all southern roads cotton was formerly much the most important single article moved, and it was a leading source of revenue. To some extent this state of things has been changed by a considerable increase of other traffic. In some of the southern states the granger system of fixing rates by law, or by railway commissioners, has been introduced. Efforts to enforce it created antagonism, and led to the organization of influential parties for the purpose of securing a material modification or repeal of the laws giving rate-making powers to commissioners. The principal popular following of such organizations was secured in districts in which there was an earnest desire to secure the construction of new lines, on account of the difficulties they encountered in efforts to secure the aid of capitalists who were averse to making large new investments in states in which rates were fixed by law or commissioners.

The character of some of such freight tariffs is partially indicated by the following statement, published in the report of the Missouri railroad commissioners for the year ending December 31st, 1882:—

Freight rates—special classes, as established by law and by the Missouri railway commissioners, to take effect July 10th, 1878. See sections 4 and 12 of law of March 29th, 1875.

Distance.	D. All grain in car loads.	E. Flour in lots of 50 barrels or more. Lime 24 barrels or more.	F. Salt 60 barrels. Cement, water-lime, and stucco 24 barrels.	G. Lumber, lath, and shingles in car loads.	H. Live stock in car loads.	I. Agricultural implements, furniture and wagons.	J. Coal, brick, sand, stone ties, cord wood, and heavy fourth-class articles in car loads.
Miles.	100 lbs.	Bbl.	Bbl.	Car.	Car.	Car.	Car.
25	.06	.12	.15	$8 00	$10 00	$11 00	$8 00
50	.10	.20	.21	13 00	14 00	17 00	10 50
63	.11	.22	.22½	14 50	16 00	18 50	11 00
75	.12	.24	.24½	15 00	18 00	20 00	12 50
88	.13	.26	.26	16 50	20 00	21 50	13 00
100	.14	.28	.28	17 00	22 00	23 00	14 00
113	.15	.30	.29½	18 50	23 50	24 50	15 00
125	.16	.32	.31½	19 00	25 00	26 00	16 00
138	.17	.34	.33	20 50	26 50	27 50	17 00
150	.18	.36	.35	21 00	28 00	29 00	18 00
163	.19	.38	.36½	22 50	30 00	30 50	19 00
175	.20	.40	.38½	23 00	32 00	32 00	20 50
188	.21	.42	.40	24 50	34 00	33 50	21 50
200	.22	.44	.42	26 00	36 00	35 00	23 00
213	..	..	.43½	26 50	38 00	36 50	24 00
225	.22½	.45	.45½	27 00	40 00	38 00	25 50
238	..	..	.47	28 50	42 00	39 50	26 50
250	.23	.46	.49	29 00	44 00	41 00	28 00
263	..	..	.50½	30 50	46 00	42 50	29 00
275	.23½	.47	.52½	31 00	48 00	44 00	30 50
288	..	..	.54	32 50	50 00	45 50	31 50
300	.24	.48	.56	33 00	52 00	47 00	33 00
313	..	..	.57½	34 50	54 00	48 50	34 00
325	.24½	.49	.59½	35 00	56 00	50 00	35 50
338	..	..	.61	36 50	58 00	51 50	36 50
350	.25	.50	.63	37 00	60 00	53 00	38 00

When rates are not shown in the above table for the exact distances, the rate given for the next greater distance should be used.

In fixing rates the distance is to be computed from the point where the freight is received in this state, notwithstanding it may pass from one road to another.

All articles not named in headings above, in classes F, I, and J, will be found in the classification of freights established by the railroad commissioners of the state of Missouri, to take effect February 1st, 1880.

THE PACIFIC RAILROADS.

On these lines, as on all other American railways engaged in extensive movements, there has been a gradual reduction of average rates, as business and competition increased. Originally some of the charges for local traffic and for through passenger movements were relatively high, partly on account of the sparse population of many of the districts traversed, and consequent necessity of imposing high rates to earn interest on cost of construction, and partly on account of the high rates for transportation which prevailed in those districts before the railways were constructed. An indication of the state of things during a brief period is furnished by a statement that on the Kansas Pacific, about 1868, the average rate paid for moving Government freight was 10.53 cents per ton per mile, and the passenger rate was 7.58 cents per mile. Government troops were charged 8.05 cents per mile, on account of excess of baggage. Even higher rates were charged on some portions of other Pacific roads. While the Central and Union Pacific continued to furnish the only through-rail passenger route between the Missouri river and the Pacific coast through passenger rates were also kept at an unusually high figure, but after several transcontinental routes were opened considerable reductions were soon made in all classes of charges, and during sharp competitive strifes exceedingly low rates have at times been established. The general movement on the Central Pacific and Union Pacific is shown by the following statements, furnished in a report of the United States commissioner of railroads:—

Central Pacific Railroad.

Years.	Passengers. Carried one mile.	Passengers. Gross receipts.	Passengers. Average per passenger per mile, cents.	Freight. Tons carried one mile.	Freight. Gross receipts.	Freight. Average per ton per mile, cents.
1870.	......	$3,581,506 18	....	......	$3,232,479 25	....
1871.	......	3,486,239 29	....	......	4,653,811 65	....
1872.	106,120,000	4,065,210 00	3.83	190,510,000	6,967,444 58	3.66
1873.	120,858,000	4,418,417 42	3.66	248,793,000	7,462,894 92	3.60
1874.	134,318,000	4,723,866 94	3.52	280,395,000	7,986,894 92	2.85
1875.	168,336,000	5,509,369 32	3.27	316,593,000	9,938,303 58	3.14
1876.	172,639,000	5,589,304 43	3.24	363,460,000	10,773,618 34	2.96
1877.	181,715,000	5,483,704 35	3.02	363,542,000	10,095 349 87	2.78
1878.	178,773,325	5,204,913 07	2.96	392,281,710	10,802,276 40	2 75
1879.	180,779,711	4,919,254 63	2.72	392,950,000	10,934,573 39	2 78
1880.	191,415,400	5,819,794 23	3 04	565,063,768	13,245,857 79	2.34
1881.	218,117,760	6,692,828 27	3 07	733,285,899	15,842,139 01	2.14
1882.	255,824,363	7,474,216 12	2.92	902,981,309	16,302,882 72	1.81
1883.	291,109,508	7,945,826 07	2.73	775,976,492	14,932,969 94	1.92

Union Pacific Railway.

Years.	Passengers. Carried one mile.	Passengers. Gross receipts.	Passengers. Average per passenger per mile, cents.	Freight. Tons carried one mile.	Freight. Gross receipts.	Freight. Average per ton per mile, cents.
1870.	74,917,335	$3,818,627 55	5.10	71,779,106	$3,058,514 71	4.26
1871.	73,994,927	3,123,510 08	4.22	134,205,887	3,629,488 94	2.70
1872.	80,663,871	3,370,312 41	4.18	178,145,755	4,768,419 07	2.67
1873.	95,709,054	3,887,204 48	4.06	223,361,542	5,516,907 58	2 47
1874.	105,138,205	3,952,858 55	3.76	262,238,837	5,664,731 33	2.16
1875.	132,591,343	4,346,014 00	3.28	269,414,989	6,641,512 00	2 47
1876.	128,032,924	4,307,602 00	3.36	292,002,076	7,304,123 00	2.50
1877.	107,883,371	3,599,756 00	3.34	334,644,870	7,597,681 00	2.27
1878.	96,304,250	3,150,409 00	3.27	366,014,080	8,295,878 00	2.27
1879.	100,151,148	3,207,910 00	3.20	436,054,149	8,692,414 00	1.99
1880.	161,890,901	5,405,125 00	3.33	660,472,084	13,617,024 67	2.06
1881.	153,570,005	5,131,571 39	3.34	783,331,084	15,559,528 00	1.99
1882.	157,527,336	5,197,769 96	3.30	732,791,054	13,905,489 63	1.89
1883.	148,953,839	4,659,116 16	3 13	705,781,630	14,268,291 31	2.02

The opening of the other transcontinental routes is of comparatively recent date. An announcement of the rates charged for through business shortly after the Northern Pacific had completed a rail connection with the Pacific coast, in October, 1883, by the agents of that company, stated that the through rates in force by all the rail lines to Portland, Oregon; San Francisco, California; New Tacoma and Seattle, Washington Territory, and all rail points east of Portland and west of lake Pend d'Oreille, subject to west-bound through classification, were as follows:—

From—	First class.	Second class.	Third class.	Fourth class.	Class A.	Class B.	Class C.	Class D.
New York	$6 00	$5 00	$4 00	$3 00	$2 50	$2 00	$1 75	$1 50
Pittsburgh	5 43	4 53	3 62	2 71	2 50	2 00	1 75	1 50
Cincinnati and Indianapolis	5 31	4 25	3 45	2 65	2 39	2 00	1 75	1 50
Chicago and St. Louis	5 00	4 00	3 25	2 50	2 25	2 00	1 75	1 50
St. Paul, Duluth, Minneapolis and Superior	4 55	3 75	3 00	2 35	2 10	1 85	1 60	1 35

During sharp competitive struggles which occurred after 1883 the through rates between New York and San Francisco fell to much lower figures than those given above. It will be seen that the charges were for class D $1.50 per hundred pounds, equivalent to $30 per ton, or approximately one cent per ton per mile.

The following extracts from a speech delivered by Hon. Leland Stanford, of California, who was for years president of the Central Pacific, in the United States Senate on January 10th, 1887, show that after 1883 freight was often carried, on the Southern Pacific, between the two oceans, for $10, or at about the rate of one-third of a cent per ton per mile, while $30 per ton was sometimes charged for a movement over half this distance, and that in California 15 cents per ton per mile had at one time been charged on a small amount of traffic:—

"The Southern Pacific road strikes the Atlantic waters at a much less distance than any of its northern competitors. It has a line of easy gradients comparatively, and it competes not only with its northern rivals, but more particularly with the Cape Horn and Isthmus of Panama routes, because of its shorter line and easy gradients. In this competition it often takes freight between the two oceans as low as $10, while it takes freight half way for, say, $30 a ton, a most reasonable rate for the limited local business of that country. Now, if it makes only a dollar a ton net on the freight from San Francisco to New Orleans at $10, it is glad to make that dollar where it can get no more; but a ton of freight going to El Paso, something over half the distance, will pay $30 a ton. Now, if the freight at $10 to New Orleans pays $1 profit, the freight going a less distance, to El Paso, would pay as much profit as twenty-one tons going through to New Orleans; and the rates charged to El Paso are but fair, as is shown by the gross earnings and the gross expenses of the road, leaving but a very narrow net profit. . .

Since the first road was built in the United States up to this time the roads have substantially fixed their own rates for service, until to-day the rate is such as was not dreamed of as possible twenty years ago, nor was it believed possible even ten years ago. The whole country is developed. No product has suffered for want of movement. The general railroad management of the country is careful to consider what the cheap unmanufactured products of the country can afford to pay, and make their rates with a view that production shall not be hindered. The rates charged for manufactured goods, almost without exception, do not affect the producer or consumer. If the rates of freight upon manufactured articles were reduced one-half, the probabilty is that there is nothing that moves by railroad over the longest line in the country whose price to the consumer would be affected or would be taken into consideration by the manufacturer; but the fractional part of a cent becomes a serious consequence in the long haul to most of the raw products of the country. The higher the maximums the lower the possible minimums.

Thus in my own state the maximum rates were 15 cents per ton per mile. With an average cost of 2 cents a mile for movement, which was about the average at one time, 1 ton of freight moved at 15 cents a ton per mile would enable the railroad to move 14 tons at the minimum rate of 1 cent a ton per mile. There was at that time about 1 per cent. of the business done at the maximum rate, while the other 99 per cent. was done at rates governed by circumstances and influences which the railroad company could not control."

RELATION BETWEEN THROUGH AND LOCAL RATES.

REDUCTIONS OF RATES DURING RAILWAY WARS.

THE average reductions in rates do not afford an adequate idea of the ridiculously and injuriously low figures to which rates have frequently been reduced during eras of reckless or acrimonious competition. The average rates reported necessarily represent much higher figures than those paid for the cheapest movements made, and there are reasons for supposing that the magnitude of excessively and injuriously cheap movements has frequently, if not generally, been a leading cause of the extraordinary reductions in average rates which are officially announced.

The exact state of facts illustrating the extent to which local and non-competitive movements have, on various lines and at various periods, shared in the reductions granted to shippers who moved freight between relatively distant competitive points, could only be ascertained by exhaustive inquiries. Any general assertion on this subject could apparently be proved or disproved by minute evidence explaining the conflicting records and practices of different corporations at different times. On the one hand there can be little doubt that many companies have endeavored, during protracted periods, to steadfastly maintain such rates pertaining to all classes of local traffic, as were deemed necessary to earn interest on their indebtedness and dividends on their stock, even while they were rapidly reducing rates on competitive traffic. On the other hand, some companies allege that they have never lost sight of the importance of making reductions on the classes of local freight movements which would be materially affected by war rates simultaneous with the adoption of the latter.

The most important lesson of the experience of a series of years bearing on this subject is that protracted and extensive reductions of rates for classes of competitive traffic between different points, which compete actively with the local interests tributary to any leading road, operate injuriously to that road as well as to the local interests dependent exclusively upon it for transportation facilities, unless there are contemporaneous reductions of the corresponding local rates, and that for this reason, if for no other, long lines should either avoid such a lowering of rates as occurs during severe competitive struggles or be prepared to make extensive concessions to local shippers.

Out of these conditions have grown two things of great moment: First, numerous efforts by representatives of companies engaged in active competition for all leading classes of through competitive traffic to avert or prevent railway wars, and to maintain through rates at all times at something like a reasonable standard; and second, a permanent lowering of many classes of local rates on many lines at an earlier period than it would probably have occurred if overwhelming influences had not frequently reduced through rates to excessively low standards, and made most of the through rates of this country at all times much lower, per ton per mile, than the corresponding railway rates of any other country.

HOW LOW A RAILWAY WAR RATE MAY FALL

is a matter of conjecture. It bears no relation to cost of movement or any other appropriate influence. Immense quantities of freight have been moved over long distances for remuneration that fell far below the inevitable cost of such movements, exclusive of any allowance whatever for the capital employed in constructing permanent way and maintaining equipment. It has been said of some of these war rates that they scarcely paid for the oil used in lubricating the locomotives and car wheels that made the movements. Passenger fares have sometimes been cut in similar proportions, even to the extent of carrying persons long distances for about a mill per mile. Of one of the strifes which occurred in the early portion of the seventh decade, in regard to live-stock traffic, the report on internal commerce of the United States for 1879 says: "It is stated that at one time cattle were hauled from Chicago to Pittsburgh without charge, and that in certain instances they were hauled from Chicago to the seaboard for $5 per car load. That this rate was below the actual cost of transportation may be inferred from the fact that the rate now (December 1st, 1879), prevailing is about $110 per car load, and is regarded as reasonable. One of the strategic expedients adopted on the part of an aggressive company was to force its antagonist to a rate below the actual cost of transportation, and then to divert as large a portion as possible of the unremunerative traffic to that road, thus compelling it to bear the principal part of the loss incurred."

An outgrowth of a severe contest between the Pacific roads was a report that a Boston merchant, who was in the habit of having lemons shipped to his warehouse overland from southern California, concluded that excessive low rates would enable him to extract a profit from an overland shipment of lemons back to southern California. If this statement is true, it shows that one of the longest railway overland freight movements in the world could at one time be profitably duplicated on account of its excessive cheapness and a fluctuation in the market price of the article to which it related. Similar stories have been told, at various periods, of other products, such as the shipment of corn westward from eastern points to Chicago, an operation equivalent to carrying coals to New Castle, partly on account of a speculative flurry in its price, but more particularly on account of excessively low rail rates.

In the testimony of Homer E. Sargent, general superintendent of the Michigan Central, before the Senate committee on transportation to the seaboard, in September, 1873, he said:—

"There are periods, in the competition and disagreements and misunderstandings between the competing lines, that we bring freight west now for short times at two-thirds of a cent per ton per mile. The lines east and west have been bringing first-class goods between New York and Boston, Philadelphia and Chicago, for two months past, at about forty cents per hundred. Forty-two and a half cents per hundred by our line would be a cent a ton a mile. They have been bringing groceries and the fourth-class goods at about 25 to 30 cents; that is about two-thirds of a cent per ton per mile."

In a speech delivered by Sir Henry W. Tyler at a half yearly meeting of the stockholders of the Grand Trunk Railway of Canada, held in London on October 30th, 1877, he said that the average freight receipts of that line had fallen to .86 of a cent per ton per mile during the previous half year, "mainly on account of the mad competition which was carried on for American traffic by railway before the opening of navigation, and on the lakes and canals after the opening of navigation."

In a speech delivered on June 30th, 1879, to the stockholders of that company, he said: "It is quite true while I was out in America grain was being carried from Chicago to New York at the rate of 7½ cents per 100 pounds, or a good deal less than the cost of conveyance. Since then the rate has been raised to 15 cents, and since my arrival in England I have received a cable message informing me a further agreement has been made to raise it to 20 cents."

In an address delivered to the American Society of Civil Engineers, by O. Chanute, Esq., in May, 1880, he said: "The regular rate from Chicago to New York, upon domestic produce (grain, flour, provisions, lard, &c.), is now $\frac{5}{8}$ of a cent a ton a mile, and in times of sharp competition has been $\frac{2}{10}$ of a cent a ton a mile."

Similar illustrations of the effect of railway wars on the operations of nearly all classes of lines that have participated in extensive freight movements might be furnished. They have occurred so often, and in so many localities, that they have formed a leading feature of a large proportion of the operations of the American railway system, which has, indeed, been arranged on such principles that they are almost sure to occur at irregular intervals unless exceptionally judicious and effective preventive methods are adopted.

EFFECT OF RAILWAY WARS IN INCREASING DISPARITY BETWEEN THROUGH AND LOCAL RATES.

It is obvious that a considerable proportion of the popular dissatisfaction with local freight charges, which has been manifested at various times and places, grew out of excessively low rates charged for through movements during acrimonious contests between rival lines. The position of the combatants in such struggles is far from enviable, as they must choose between an abandonment of an important class of business, built up at great expense by years of persistent effort, and a reduction of rates to the level fixed by eager competitors, which may involve not only a money loss on the actual movements made, but also serious indirect losses arising from injuries inflicted on local interests served. This is an age of competition, and the same impulse, principle, or law of trade that has encouraged excessive competition between transportation companies has exerted a similar influence on the producers, residing in different sections, of all important surplus staples of agriculture, mining, and manufacturing development. Many of these products possess comparatively small value in proportion to bulk, and require transportation over a considerable distance to reach an available market, and their value to the original producer at any given interior point may be quickly and seriously affected by any system of freight charges that gives superior facilities or materially lower rates to rival producing regions. This fact, and the bearing of railway war rates upon many local industries and interests, accounts for much of the discontent with freight tariffs that has been excited at sundry times and places.

LEGITIMATE CAUSES OF DIFFERENCES BETWEEN THE RATES PER TON PER MILE APPLIED TO LONG AND SHORT MOVEMENTS.

In some of the early freight tariffs of this country, especially such as were devised when public works remained under the control of state governments, there was little or no difference, based on length of movement, in the tolls imposed, per ton per mile. Chiefly in consequence of this failure to "discriminate" a number of such works failed to accomplish one of the leading objects of their construction, which was to attract trade from comparatively distant points. The reasons for such failures were pointed out by Robert Fulton before any important canals or railways were constructed in this country, and he sketched at that time the outlines of a freight tariff, or toll sheet based on the principle of diminishing average rates per ton per mile as distance was increased, which would be necessary to stimulate movements of cheap and bulky articles over long distances. The toll sheet recommended by Fulton for the accomplishment of this purpose has already been published, and if due allowance is made for inevitable variations in details, it may be said that its features relating to discriminations between long and short movements have substantially furnished the basis of all the modern freight tariffs of this country. It may be accepted as an axiom that all cheap and bulky articles which are moved over long distances must have the benefit of lower rates per ton per mile than those established for short distances. Otherwise the long movements cannot be made, as the market value of the product is consumed by transportation charges to an extent that does not leave a remunerative compensation to the producer.

Another reason for the difference between through and local rates per mile is based on the fact that in a considerable proportion of the service rendered the expense to the transportation company is as great on a short movement as on a long one, or it may even be, and often is, considerably greater. The clerical and terminal service, including loading and unloading, receipts, delivery, billing, and collection of freight, as a rule, costs quite as much for the short movement as the long one, and often these charges are proportionally much greater on local movements than on long movements.

W. M. Grosvenor formulated reasons for a diminution of the cost of rail movements per mile on account of an increase of the distance traversed in the following statement:—

"The regularity of decrease in rates charged corresponds with a general law governing all railway service, namely, cost of loading and unloading and fixed expenses being the same, whether the trip is long or short; cost of transportation per ton per mile regularly decreases as distance increases, being cost of haulage plus fixed cost, divided by the number of miles. Thus, if cost of loading and unloading be 33 cents, and other items of fixed cost 27 cents per ton, the actual cost of haulage (maintenance of track, repairs, &c., included) being $\frac{83}{100}$ of one cent per ton per mile, the cost for different distances will be .83+60 cents divided by the distance, thus:—

Miles.	Haulage.	Fixed charges. Cents.	Total charge per ton per mile. Cents.
10	.83	6 00	6.83
20	.83	3.00	3.83
30	.83	2.00	2.83
40	.83	1.50	2.33
50	.83	1.20	2.03
60	.83	1.00	1.83
80	.83	.75	1.58
100	.83	.60	1.43
150	.83	.40	1.23
200	.83	.30	1.13
300	.83	.20	1.03
400	.83	.15	.98
500	.83	.12	.95
1,000	.83	.06	.89

In a speech delivered by George B. Roberts, president of the Pennsylvania Railroad Company, before a committee of the Pennsylvania legislature, he said:—

"I want to go one step further and endeavor to show you that, under certain circumstances, it costs more to haul goods a short distance than a long one. In other words the principle that seems generally to be accepted by the public, that no railroad or transporting company shall be permitted to charge more for a short distance than a long one, while it may seem to be correct, can easily, upon examination, be shown to be a fallacy; and best, probably, by giving you some illustrations, from the road with which I am most conversant. I have no doubt the same thing will apply to other roads in the state, but as I have been brought up with the Pennsylvania Railroad, and know more about it, I will refer to that.

If a cargo of coal is delivered to the Pennsylvania Railroad, say at Thirty-sixth street, Philadelphia, for Hestonville, a distance of only about two miles, it passes through a crowded yard, crosses over the passenger tracks, and must be hauled by a special engine. There are times in which it would pay the Pennsylvania Railroad to give that man enough money to wheel his coal up there rather than to haul the car. If that same cargo of coal had been delivered to the company, at some point like Lancaster, to be transported ten, fifteen, or twenty miles, a moderate rate per ton per mile would have paid for the service, and it would have been cheerfully carried. Say the rate on coal is one cent a mile, which is a large one; if the car is fully loaded the company would get forty cents for pulling it two miles. If it were ten miles out on the line, and the rate half a cent a mile, it would make two dollars for the ten miles, which would be a good rate under most circumstances; but, as I said before, it would be many times better for them to pay fifty dollars than pull that car of coal the two miles between Thirty-sixth street and Hestonville. Another instance outside the state will furnish an equally good illustration. The distance from Newark to New York, is about ten miles. The amount received for carrying a ton that distance, if you take the average through rates, would be eight cents; while the rent alone of the wharves in New York, over which that traffic has to be handled, amounts to twenty-two cents for each ton that passes over them. Therefore, there would be a loss of fourteen cents on every ton moved, in addition to the entire cost of hauling and the terminal expense of handling it. The terminal costs and the expenses of the yards from which the traffic starts aggregate an enormous sum, and I think it is safe to say that if the traffic of the Pennsylvania Railroad were to start at Philadelphia, and not go beyond Lancaster, it would be carried at a loss. It has to be moved as far as Harrisburg before the distance makes the traffic profitable. All the money that we receive from short distances from the large points, say for the first hundred miles, is nearly consumed by the terminal expenses.

Another matter which has an important bearing upon economy of movement is the back loading of cars. Whenever a company is moderately sure of obtaining a back loading, so as to have its cars earning both ways, it can carry traffic cheaply; but if it has to haul its cars loaded in one direction and empty in another, it is hardly necessary for me to tell you that it must charge higher rates."

In the testimony of J. D. Hayes, general manager of the Blue Line, before the United States Senate committee on transportation routes to the seaboard, submitted on September 13th, 1873, he said:—

"Much has been said with regard to the extraordinary charge on local business as compared with the through business, and a very great popular error has grown out of the discussion of that question, much to the injury of railroads, and of no benefit to the consumer or producer. If a car load of property has to be received at a local station, the rule governing common carriers is that they are liable for the property from the time they receive it until it has reached its destination. Therefore, the cost of handling that into store and out again into the cars is just as great to run five miles as it is to run five hundred miles or one thousand. Suppose, for instance, that we receive a car load of grain to haul fifty miles, and put it at a reasonable rate, the cost of handling that property could not be less than 20 cents per ton. There would be $2, if a 10-ton car was used. If that property has to be unloaded to go into another company's car at the terminus of its road, at the end of 50 miles, the cost of unloading it is $2 more. The cost of an engine to go into switch and take that is spread over the entire train that is waiting. Therefore, a local freight train to run 100 miles a day accomplishes less work than a through-freight train running 300 miles in same time. If you apply say the one cent per ton per mile of the through business to the one cent per ton per mile for the local business, and deduct your terminal for the receiving and discharging, which is $4, you have $1 left as the proceeds of transportation for 50 miles. You will see at once that could not possibly be done. . . . All local freight must of necessity bear a much larger proportion to cost per ton per mile than through freight drawn in full trains over long distances."

A variety of other considerations enter the questions involved in the relations between through and local rates. At many small stations the expenses for establishing and maintaining them bear so large a proportion to the entire receipts that it is impossible for railway companies to derive any clear profit whatever from all the movements made at them. In some other countries, and notably in England, freight bills are usually itemized to an extent rarely followed in the United States, and terminal charges form an important element of the amounts paid. Americans usually prefer paying a round sum, which covers all costs, and deference to this proclivity has led to the adoption of practices in making out freight bills which increase the difficulties of securing adequate compensation for expensive terminal facilities.

If due allowance be made for the disturbing and demoralizing influence of railway wars, which temporarily derange everything that vitally affects the normal relations between through and local rates, for the necessity for granting relatively low through rates if any long movements of cheap and bulky articles are to be made, and for the radical difference in average cost per ton per mile which inevitably exists between long and short movements, it will probably be found that many of the railway lines of this country have, during lengthy periods, zealously endeavored to avoid, as well as possible, unjust discriminations against local interests and industries. It is certainly their interest to adopt such a policy, because any course that tends to permanently diminish the prosperity of the regions that are exclusively served by any particular line saps its vitality, and leads to reductions in its net revenues. There is little to be gained, and much may be lost, by increasing the competitive traffic of distant regions which must be shared with half a dozen eager competitors, when such an increase can only be secured under conditions that inflict serious injuries upon local interests exclusively served, which are not counterbalanced by corresponding local advantages. The substantial welfare of every railway company is closely interwoven with the welfare of the regions traversed by its lines.

A comprehensive statement of the relation that prevailed on the east and west trunk lines, between charges for movements of 50, 75, 100, 150, 200, 250, 300, and 350 miles in length, respectively, was furnished by the following table published in March, 1875, and pertaining to the rates in force about that time:—

COMPARATIVE STATEMENT OF LOCAL FREIGHT RATES CHARGED BY THE FIVE TRUNK LINES FOR THE SAME OR SIMILAR DISTANCES.

	Miles from given point to station nearest the distance taken.	Kind of freight. 1st class.	2d class.	3d class.	4th class.	Flour p. bbl.	Miles from given point to station nearest the distance taken.	Kind of freight. 1st class.	2d class.	3d class.	4th class.	Flour p. bbl.
		FOR 50 MILES.						FOR 200 MILES.				
Erie.—Regular rate from Jersey City	50	22	17	12	9	18	200	56	42	30	23	46
New York Central.—Winter, from Albany	55	24	21	16	11	..	199	61	50	40	24	..
Pennsylvania.—Summer, from and to Phila.	50	19	16	14	11	20	200	66	56	46	36	67
Grand Trunk.—Summer, from Portland	55	28	23	19	14	22	203	54	45	36	27	44
Baltimore and Ohio.—Regular rate from and to Baltimore	50	20	20	19	16	32	201	72	59	52	40	80
Average rate	..	22⅗	19⅖	16	12⅕	23	..	61⅘	50⅖	40⅘	30	59¼
		FOR 75 MILES.						FOR 250 MILES.				
Erie*	75	27	21	15	11	22	248	67	50	36	28	56
New York Central*	74	26	23	19	13	..	253	65	53	49	28	..
Pennsylvania*	75	25	21	18	15	28	250	71	56	46	36	72
Grand Trunk*	75	30	25	20	15	24	250	60	50	40	30	45
Baltimore and Ohio*	75	30	30	25	23	46	253	95	73	60	40	80
Average rate	..	27⅗	24	19⅖	15⅖	30	..	71⅗	56⅖	46⅕	32⅖	63¼
		FOR 100 MILES.						FOR 300 MILES.				
Erie*	100	34	26	19	14	28	300	78	59	43	33	66
New York Central*	101	33	28	25	15	..	309	70	55	51	31	..
Pennsylvania*	100	30	25	20	15	30	300	71	56	46	36	72
Grand Trunk*	103	36	30	24	18	28	300	60	50	40	30	50
Baltimore and Ohio*	100	40	40	34	30	60	300	95	80	60	40	80
Average rate	..	34⅗	29⅘	24⅖	18⅖	36½	..	74⅘	60	48	34	67
		FOR 150 MILES.						FOR 350 MILES.				
Erie*	153	45	34	24	19	38	351	86	65	47	38	76
New York Central*	156	48	42	36	22	..	349	76	60	50	34	..
Pennsylvania*	150	44	37	33	26	48	350	71	56	46	36	72
Grand Trunk*	150	44	37	29	22	36	350	70	58	47	35	60
Baltimore and Ohio*	152	61	50	42	36	72	350	95	80	60	40	80
Average rate	..	48⅘	40	32⅘	25	48½	..	79⅗	63⅘	50	36⅗	72

* Same points and seasons as above

It will be seen that while there was some variation in the charges of the different lines, the average rates for 150 miles were about double the rates for 50 miles, and the average rates for 350 miles were on most classes slightly more than three times the charges for 50 miles.

METHODS OF REGULATING RATES BETWEEN NUMEROUS COMPETING POINTS.

One of the most important aims of the modern railway pooling systems of the United States was the maintenance of an approximately just relation between local and through-freight charges, and, in a broad sense, this object was substantially accomplished by the important pooling systems during the periods when they were in successful operation, so far as they could or did affect every competitive point reached by lines connected with each of the respective pools. The general principle adopted was to vary the charges between all competitive points reached by the lines of each pool to an extent that corresponded, with varying degrees of nicety, to differences of distance or other elements in cost of transportation. In the east and west trunk-line arrangements these differences were formulated in percentage tables, so arranged that while 100 represented the charges between New York and Chicago, other figures, running above 100 to 122, represented the charges to more distant or more inaccessible points, while lower figures, running down to 55, represented the charges between New York and points more readily reached than Chicago. These percentage tables were discussed from time to time, and sometimes changed.

In a circular issued by Albert Fink, trunk-line commissioner, on July 26th, 1883, percentage tables are published which show the relation existing at that time in the freight charges between New York and 239 points on both east-bound and west-bound traffic, these points including every city and important town reached by competitive lines in Ohio, Indiana, Michigan, and Illinois, and prominent cities on the eastern borders of Iowa and Missouri, and the northern borders of Kentucky and West Virginia. The same table, with accompanying explanations, explained methods for computing rates pertaining to all the points named to and from Philadelphia, Boston, and Baltimore. It is difficult to conceive of any better method for establishing substantial safeguards against injuriously unjust discriminations against sections or localities than that provided by the system represented by these percentage tables. Questions naturally arose as to whether the percentage of a particular town or city should be raised or lowered, but a definite position was given to each place, in the matter of freight charges, which was at least approximately just, and this position was secured to it while the pooling arrangements applicable to the subject were faithfully enforced. In July, 1883, if 100 represented the charge from Chicago to New York, 116 represented the charge from the more distant point of St. Louis, 90 the charge from the nearer point of Fort Wayne, Indiana, and 71 the charge from the still nearer point of Cleveland, Ohio, and similar gradations were established in the charges for freight movements between all the important north Atlantic seaports and all the important towns and cities of the Western states.

PASSENGER RATES AND ACCOMMODATIONS.

On most railways the reduction in passenger rates has not kept pace with the reduction in freight tariffs; and as a general rule there has been a closer adherence to the maximum fares authorized in charters than to the authorized maximum charges for moving freight. To this rule, however, there are many exceptions, especially in connection with suburban and excursion passenger traffic; and on a number of roads there has been a considerable reduction in all classes of fares, which was brought about, in some instances, by legislative enactments, in others by competition, and in others by voluntary regulations. By

IMPROVEMENTS IN THE CHARACTER OF THE SERVICE RENDERED

the public secures a much larger equivalent for a given sum now than formerly. Station accommodations, the number and speed of trains, the appliances for securing safety and taking care of baggage, the amount of comfort obtainable in cars from their arrangement for heating, lighting, seating, and ventilating, the number of parlor, dining, and sleeping cars, have all been increased to an extent that goes far to render journeys that would at one time have been exceedingly toilsome a source of continuous pleasure.

A large majority of the patrons of railways contribute to their revenues by paying fares rather than freight bills, and favorable or unfavorable judgments of particular lines are frequently based on opinions relating to stations, speed, and character of trains and car accommodations. It may be set down as an axiom that no road makes a good impression which fails to please its passengers, and it is vitally necessary that every ambitious line should be popular. For this or other reasons the managers of many lines have been anxious to make every possible effort to meet the expectations of travelers, and to outstrip rivals in this respect, even when there was little prospect that the outlays for such a purpose would prove directly remunerative.

One of the results of this condition of affairs has been a variety of rapid improvements in everything relating to the artistic or luxurious, as well as to the indispensable features of cars, until the ordinary coaches are marvels of convenient and comfortable construction, and the highest classes are literally palaces on wheels.

Innumerable inventions and experiments, a wealth of mechanical genius, and enormous outlays of money have contributed to these advancements. As soon as a want or chance of improvement is indicated vigorous efforts are speedily made to supply the new demand. The difference between the cars of the early lines and the best cars of the present day is scarcely less striking than the difference between the best and the worst of decent dwellings. For serious discomforts, frequently combined with considerable danger, there has been substituted luxurious ease and an average amount of safety which closely borders on an absolute assurance of freedom from serious accident.

On many lines and at many places station accommodations have kept pace with improvements in cars, elegant and commodious edifices taking the place of rude sheds, and some of the finest structures of the land being placed at the service of railway passengers.

The aggregate outlay for these purposes represents such a large sum that many of the companies that have helped to swell it have never secured an adequate return. Most companies must derive their profits chiefly from freight movements, and

PASSENGER TRAFFIC IS FREQUENTLY A SOURCE OF LOSS,

rather than of direct gain. A veritable account of the financial and physical workings of many lines would show that if due allowance were made for the wear and tear of fast trains, for the interruption of freight and slow passenger trains, and for the expenditures made for improvements in cars and stations, the traveling public has often been accommodated at the expense of stockholders or creditors.

There are some companies, however, which derive a large proportion of their revenues from passenger movements; and there are certain classes of passenger traffic, of growing importance, such as the journeys of persons who daily travel between country residences and cities, or movements between crowded cities and adjacent seaside or other popular resorts, which can be stimulated by reductions in fares, and in respect to such movements fares have frequently been reduced to an extent that corresponds with the average reductions in freight charges.

THERE IS A WIDE DIFFERENCE BETWEEN THE CONDITIONS

that affect the different classes of passenger movements. The bulk of them are represented by the arrival and departure of trains at stated intervals, with approximate regularity, whether few or many tickets are sold. Train movements of this class are often made at a loss, especially during unfavorable weather or periods when "travel is light," and they can only be continued regularly by comparatively high fares. It is also a recognized principle that reductions in rates are more likely to stimulate travel over short routes than long ones, although to this rule there may be some exceptions in connection with excursions in which large bodies participate, or individual excursions made during summer vacations. The rates for commutation tickets, or the sums usually charged by railway companies to managers of excursion parties for carrying a large number of passengers over distances of from sixty to eighty or ninety miles, represent a great reduction below the average standard of fares, chiefly because they relate to a class of transactions in which quantity or regularity of service represents an important element of economy, and leads to results similar to those obtained in freight movements in the way of increasing volume and diminishing average charges.

In discussing this subject, an article published in the National Car Builder in 1882, says:—

"It is not of course to be expected that passenger business, as a whole, can under any circumstances be made a source of profit to the same extent as freight business; but it is a question whether it has been developed as much as it might have been, or will be in future. There is a distinction between the two that cannot be obliterated by any artificial regulations. One deals exclusively with persons and the other with things, and the things can be classified and discriminated to an unlimited extent to meet every varying condition that may arise, while, as respects persons, there is a certain rigidity and fixedness that cannot be altogether broken up by any practicable system that is likely to be suggested. All sorts of articles in the general category of freight can be carried on the same trains, the same distances, and even in the same cars, at rates per 100 pounds, ranging say from 30 cents to 100 cents for a thousand miles, although the actual cost of the transportation is the same for all. In a word, freight traffic is of such a nature that, in the matter of charges, it can accommodate itself to the needs of the shipper and to almost every phase of the markets. Passenger traffic cannot be manipulated in this way except to a very limited extent. It has to contend with many disadvantages which are not incidental to freight traffic—heavy and costly cars; an average load not exceeding 60 persons per train; the necessity of making regular trips, and of running two or three times as fast as freight trains with a correspondingly heavier tax on the motive power; incumbrance of free baggage and free-pass dead-heads; and the tendency of postal, telegraph, and express facilities to diminish its revenues. Of all these, the heaviest millstone it has to carry is, perhaps, the drawing-room and sleeping-car equipment. This it must always carry, because it is the attractive and showy side, the front, as it were, of the railway system, its showiness and costliness being the popular index for gauging the enterprise and standing of the respective roads in their relations with the traveling public. Under the spur of competition, our railway companies, in their zeal to head off rivals, have a little overdone the thing in the matter of fine cars. The public demand for luxurious accommodations is not easily satisfied, but grows by what it feeds upon. Something more and better is wanted, whether attainable or not."

STEADINESS OF FARES ON MANY LINES.

On many lines the fares for ordinary movements have varied comparatively little during lengthy periods. The following statements of the fares on the roads named below are contained in Appleton's Railway Guide for February, 1865, and in a number of instances they do not differ materially from the sums paid a score of years later:—

Camden and Amboy Railway—New York to Washington, through fare, $8.25; way fares, about 3 cents per mile. New York to Philadelphia, express line, $3; accommodation line, $2.25; second class accommodation, $1.75; emigrant, $1.50.

Raritan and Delaware Bay Railway—From Brooklyn to Philadelphia, $2; excursion tickets from Brooklyn to Philadelphia and return, good for three days, $3.

Pennsylvania Central Railroad—Philadelphia to Pittsburgh, through fares, $10; way fares, 3 cents a mile when tickets are purchased at stations.

Philadelphia, Wilmington and Baltimore Railway and Connections.—New York to Washington, through fare, $8.25; way fares, about 3½ cents per mile.

New York and New Haven Railway—New York to New Haven, through fare, $1.80; way fares, about 3 cents per mile.

Morris and Essex Railway—New York to Hackettstown, through fare, $1.75; way fares about 4 cents per mile.

Long Island Railway—New York to Greenport, $2.05; way fares, about 2½ cents per mile.

Concord, Manchester and Lawrence Railway—Boston to Concord, through fare, $2.35; way fares, about 3 cents per mile.

Rensselaer and Saratoga, and Saratoga and Whitehall Railway, Albany Division—Albany to Rutland, $3.15; Troy to Rutland, $3; way fares, 4 cents per mile.

Saratoga and Schenectady Railway—Saratoga to Schenectady, through distance, 22 miles, fare, $1.

Montreal and Champlain Railway—Rouse's Point to Montreal, through fares, $2; way fares, about 3 cents per mile; distance, 44 miles.

Northern Ogdensburg Railway—Rouse's Point to Ogdensburg, distance, 118 miles; through fare, $4; way fares, about 4 cents per mile.

Great Western (Canada), and Detroit and Milwaukee Railways and Connections—Buffalo to Milwaukee, 528 miles, through fare, $16; way fares, about 3 cents per mile.

Louisville and Nashville Railway—Way fares, about 4 cents a mile.

Charleston and Savannah Railway—Charleston to Savannah, distance, 104 miles; through fare, $4; way fares, about 5 cents a mile.

Nashville and Kentucky Railway—Fares, 4 cents per mile.

Mississippi and Tennessee Railway—Fares, 4 cents per mile.

Southern Mississippi Railway—Vicksburg to Meridian, 140 miles, through fare, $4.90; way fares, 4½ cents per mile.

Spartanburg and Union Railway—Fare, 5 cents per mile.

AVERAGE PASSENGER FARES ON ROADS IN THE DIFFERENT GROUPS.

The average fares, number of passengers moved, aggregate passenger revenue, and receipts per passenger per mile moved, &c., on the railroads of each of the groups, as reported in the census statistics of 1880, are as follows:—

Group.	Passengers carried.	Average distance carried. Miles.	Passengers one mi.e.	Revenue.	Receipts per passenger per mile moved. Cents
I......	52,156,704	16 8	875,102,461	$19,497,998	2.23
II......	175,276.181	17.4	3,051,158,551	67,319,822	2.21
III......	7,463,694	44.1	329,481,519	11,577,384	3.51
IV......	22,860,130	41.9	956,334,759	27,338,124	2.86
V......	894,075	39.8	15,707,676	801,364	5.10
VI.....	11,432,553	44.8	512,427,536	17,567.107	3.43
Totals.	269,583,340	21	5,740,112,502	$144,101,709	2.51

In the entire country the reported average cost per passenger per mile carried was 1.71 cents, and the net receipts per passenger per mile carried 0.80 cents.

The relation between season (computing 12 passengers per week for time of each ticket), local including season, and through passengers, including those carried to and from other roads, in the respective groups, in 1880, was as follows:—

NUMBER OF PASSENGERS CARRIED.

Group.	Season ticket.	Local, including season.	Through.	Total.	Total number of passengers carried one mile.
I......	12,214,480	43,492,507	8,664,197	52,156,704	875,102,461
II......	10,670,810	162,978,409	12,297,775	175,276,184	3,051,158,551
III......	175,494	5,846,753	1,616,941	7,463,694	329,481,519
IV......	194,094	20,792,850	2,067,270	22,860,130	956,234,759
V......	5	275,945	118,130	394,075	15,707,676
VI......	410,368	10,791,903	640,650	11,432,553	512,427,536
Totals.	23,665,251	244,178,377	25,404,963	269,583,340	5,740,112,502

SUBURBAN TRAFFIC OR COMMUTATION TICKETS.

A large amount of suburban traffic, especially to and from New York, Philadelphia, Boston, Pittsburgh, Cincinnati, and Chicago, is conducted for exceedingly low fares. In consideration of the fact that the purchasers of monthly, quarterly, or yearly tickets pay a given sum, and as a rule make journeys in both directions daily, the railway companies render service for charges that fall far below average fares, and in many instances for considerably lower figures than the average cost of passenger movements. Well-informed railway managers have alleged that the usual rates for commutation tickets are too low to defray expenses, and that any profits that may be derived from this class of business are obtained from the rapid growth of towns and settlements along the lines which issue such tickets, and consequent increase of regular passenger and freight business for which remunerative rates are obtained.

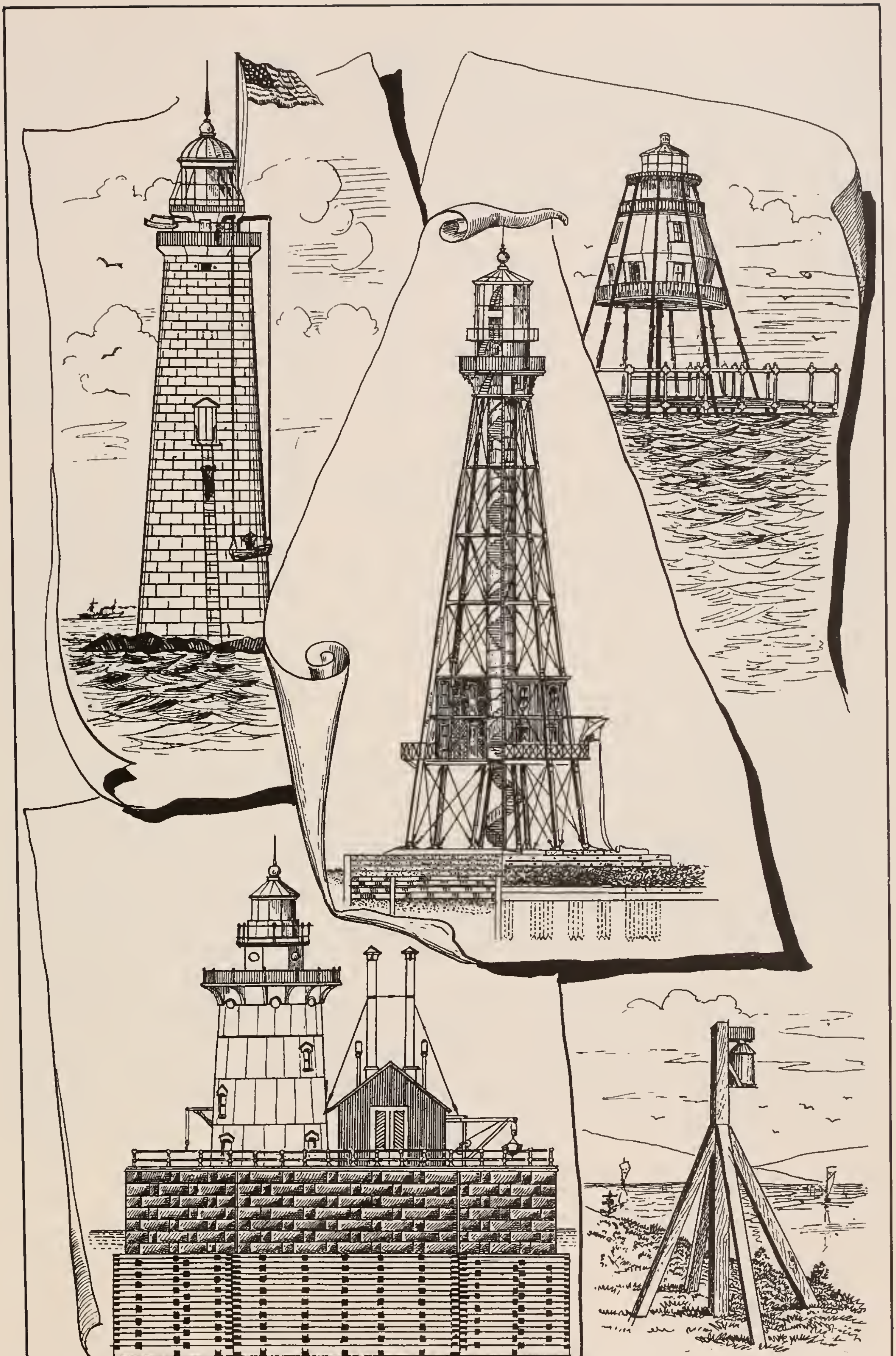
There is a considerable variety in the conditions under which suburban traffic are conducted, such as the existence of competition with street car, steamboat, or steam railway movements on some lines, and the absence of competition on other lines; the desire on the part of some managers to adopt exceptionally liberal or expensive methods for promoting the rapid development of particular localities, and the absence of such an influence in the management of other companies. These variations, and variance in the stipulations under which tickets are sold, have occasioned considerable differences in the average fares per mile charged by different companies. The reductions of fares per mile usually bear a close relation to the amount of service, and the purchasers of the tickets which extend over the longest distance for the longest period ordinarily travel at a lower rate per mile than other suburban travelers. Changes in rates for suburban traffic are also occasionally made, and fares raised or lowered. The leading features of the system, and the relation it bears to regular passenger traffic, as far as it applied to monthly tickets, and 10-trip and 25-trip rates, are shown in the following statement of rates charged a few years ago on representative roads leading out of Boston, New York, Philadelphia, and Chicago:—

Eastern (Mass.) Railroad.

Between Boston and—	Distance.	Single ticket, cents.	Monthly tickets.	Monthly tickets per mile, cents.
Maplewood	6	15	$4 40	1.36
Linden	7⅓	20	4 80	1.21
Cliftondale	8½	20	5 60	1.17
Saugus	9¾	25	6 00	1.15
Phillip's Beach	14	35	8 40	1.1t
Marblehead	17⅓	45	10 00	1.07
North Beverly	21	60	11 20	.99

Pennsylvania Railroad.

Between New York city and—	Distance.	Monthly tickets, 54 rides.	Monthly tickets per mile, cents.
Newark	8.9	$6 00	1.23
Waverly	11.5	6 50	1.65
Elizabeth	14.2	6 50	.90
Rahway	19 5	8 00	.76
Menlo Park	24.0	9 50	.73
Stelton	29.0	10 50	.67
New Brunswick	31 3	11 00	.65
Monmouth Junction	41.1	15 00	.67



LIGHTHOUSES AND RIVER STAKE LIGHT.

New York, New Haven and Hartford.

Between New York city and—	Distance.	Single tickets, cents.	Monthly tickets.	Monthly tickts per mile, cents.
Mount Vernon	14	35	$5 00	.66
Pelhamville	16	38	5 25	.60
Larchmont	18	47	5 85	.58
Mamaroneck	20	51	6 00	.58
Harrison	22	56	6 25	.53
Rye	24	61	6 50	.50
Port Chester	26	65	6 70	.48
Greenwich	28	71	7 20	.47
Cos Cob	30	75	7 70	.47
Stamford	34	85	8 20	.45

Pennsylvania Railroad.

Between Philadelphia and—	Distance.	Monthly tickets, 54 rides.	Monthly tickets per mile, cents.
Merion	6.0	$4 53	1.70
Wynnewood	7.5	4 88	1.20
Haverford College	9.1	5 93	1.19
Villa Nova	12 0	6 88	1 07
Berwin	17.5	8 83	.98
Green Tree	20.9	9 48	.92
Glen Lock	25 3	10 83	.80
West Chester	30.6	12 30	.75

Pittsburgh, Fort Wayne and Chicago.

Between Chicago and—	Distance.	Ticket rate.	10-trip rate.	25-trip rate.	54-trip monthly.	Monthly ticket per mile, cts.
Twelfth street	1.0	5	....	....	....	5 00
16th street & Bur'n Jc.	1.4	5	....	....	....	3.04
Eighteenth street	1.8	5	....	....	....	2.07
Archer avenue	2 1	5	....	....	....	2.03
Twenty-sixth street	2.5	10	$0 60	$1 25	$2 25	1.06
Thirty-first street	3.0	10	60	1 25	2 25	1 03
Thirty-fifth street	3.5	10	70	1 45	2 60	1.03
Thirty-seventh street	3.8	10	80	1 60	3 00	1.04
Boomer's	4.2	10	80	1 60	3 00	1.03
Forty-third street	4 5	15	90	1 80	3 30	1 03
Forty-seventh street	5.0	15	90	1 90	3 70	1.00
Englewood	7.2	20	1 00	2 25	4 75	1.02
Grand Crossing	9.6	25	1 50	3 05	5 60	1.07
South Chicago	12.7	30	1 75	3 90	7 25	1.06
Cassello	20.2	60	....	....	10 50	.96
Liverpool	30.5	90	....	....	12 50	.75

Comparatively little information is accessible in regard to the relation between the number of commutation tickets and the regular tickets sold to persons who travel between points to which the former apply. In the natural course of affairs, however, it is probable that at many points regular and round-trip or excursion tickets represent much more than half the travel, and thus help materially to raise the average fares per mile. In a discussion before the New York railway commission, a few years ago, vice-president Hayden, of the New York Central, said: "The working of the commutation rate was shown in the case of Poughkeepsie. During the past year 600,000 single tickets, 700,000 round-trip tickets, and 400,000 commutation rides were sold to this point."

In addition to monthly tickets, some lines issue quarterly, half-yearly, and yearly tickets, and some of the lines named above issue quarterly tickets and tickets for longer periods than three months. The yearly rates represent the lowest fares, sometimes falling to less than half a cent per mile. A good illustration of the relation between quarterly, half-yearly, and yearly service is furnished in the following statement of charges in force in 1887 on

The New York Central.

This road uses the coupon system for its suburban traffic, selling yearly books with 624 coupons, or quarterly books with 156 coupons each, as the commuter prefers. If he uses the quarterly book, the fourth quarter, as the tables indicate, costs him considerably less than the first. He may also buy monthly books, subject to a similarly discounted rate for the latter months of the year. The appended table shows the rates on the Harlem division of the New York Central for the yearly and quarterly books only:—

Between Grand Central Depot and—	Miles from New York.	Four books with 624 coupons, covering one year.	Books of 156 coupons, good for three months. First quarter.	Second quarter.	Third quarter.	Fourth quarter.
125th street (Harlem)	4.15	$30 00	$9 00	$8 00	$7 50	$6 50
Mott Haven	5 00	30 00	9 00	8 00	7 50	6 50
Melrose	6 00	35 00	10 60	9 40	8 65	7 35
Morrisania	6.50	37 00	12 50	10 90	8 95	6 65
Central Morrisania	7.29	40 00	13 45	11 75	9 65	7 15
Tremont	7.55	42 00	14 10	12 30	10 10	7 50
Fordham	8.88	45 00	14 70	12 90	10 00	7 80
Bedford Park	9 00	47 00	15 70	13 70	11 25	8 35
Williams' Bridge	10.51	50 00	16 95	14 85	12 20	9 00
Woodlawn	11.77	52 00	17 60	15 40	12 65	9 35
Mount Vernon	13.20	55 00	18 55	16 25	13 35	9 85
Bronxville	15.39	58 00	19 50	17 10	14 00	10 40
Tuckahoe	16.07	60 00	20 50	17 90	14 70	10 90
Scarsdale	18.93	65 00	22 10	19 30	15 85	11 75
Hartsdale	20.61	68 00	23 05	20 15	16 55	12 25
White Plains	22 44	72 00	24 30	21 30	17 50	12 90
Kenisco	24 45	75 00	25 30	22 10	18 15	13 45
Unionville	28.52	78 00	26 25	22 95	18 85	13 95
Pleasantville	30.99	80 00	26 90	23 50	19 30	14 30

EXCURSION TICKETS.

Several classes of excursion movements represent considerable reductions on average fares. They include, first, the tickets occasionally and systematically issued by lengthy lines, which are only applicable to points separated by a comparatively short distance; second, cheap tickets issued to incite travel to and from such popular resorts as managements specially desire to popularize; third, tickets granting the right to travel over extensive systems of excursion routes, formed either of all the lines of one company which controls a large mileage, or of combinations of portions of the mileage of a number of lines; fourth, cheap excursion rates granted over long distances to participants in important popular societary or scientific movements, such as various classes of national conventions; fifth, systematic arrangements for excursions of the members of particular lodges or societies and their friends to and from seaside or other popular resorts.

The extent to which concessions in rates are granted in connection with these classes varies materially, but they are most likely to reach exceptionally low figures per mile in connection with movements of the second and fifth classes designated above. It rarely happens that charges for excursion tickets of any other kind than these two classes fall below half a cent per mile except under the pressure of severe competition, and the charges for the first, third, and fourth classes usually represent a reduction of from one-fourth to one-half below regular fares.

COST OF RAILWAY TRANSPORTATION.

THERE is no subject connected with the development of transportation systems which is of greater importance, or that has been to a greater extent misrepresented and misunderstood, than the cost of railway movements. On their cheapness and efficiency everything else depends. They are generally the least expensive, but often the most costly, of all overland methods of moving persons and property.

Real cheapness can only be secured by such a variety of favorable conditions and circumstances, that the failure to attain it is much more common than it is generally supposed to be, and the amount of railway business conducted at a direct loss in immediate results greatly exceeds popular estimates.

INTEREST ON CAPITAL ACCOUNT.

The established method of making up railway accounts and statements helps to encourage delusions. It is based on a system of ascertaining and stating cost which does not directly take into consideration what is frequently the most important of all the items of expenditure—the sums that are or should be paid for the use of the capital that creates the railway. This mode was presumably adopted for convenience of calculation, and it is so universally used that it misleads no one who is accustomed to seek information in any of the thousands of railway reports that are issued. Those who are pecuniarily interested are sure to discover, and often to their sorrow, the relation which the excess of profit shown by an avoidance of a primary charge for the use of the capital employed bears to interest account and dividends. But, as a matter of fact, the stated cost of moving passengers and freight per mile, and the aggregate cost of all the movements made in any given year on any particular line, falls far below the actual reality, on account of the adoption of the prevalent style of book-keeping.

It is only after the supplementary comparison between reported "profits" on the one hand, and interest charges and allowance for dividends on the other, is made that an approximately correct idea of the real cost of transportation can be formed. Such calculations are rarely published. The public indeed hears, with unfortunate frequency, of lines that have failed to earn dividends, or that have been unable to promptly provide for interest payments, but few stop to think that such announcements are tantamount to an acknowledgement that, instead of the sums received from the public during the periods to which they relate representing the profit which is apparently shown, they really represent a loss or under-payment to the extent of the failure to provide for interest charges and such dividends as could justly be expected.

If a road has much traffic, and its capital account is not unusually large, the actual cost of any particular movement is enhanced to only an infinitesimal extent by its appropriate allowance for the use of money expended in creating the railway and its appliances, but if the amount of traffic is light, which is the case with a very large proportion of the existing railway mileage in the United States, and if each of the few tons of freight and small number of passengers that pass over such lines daily were charged with their due share of capitalized expenditure, that share would often form much the most important and much the largest element in the actual cost of transportation.

Out of the efforts of railway managers to secure from a combination of all practical expedients remuneration for capital, and the resistance or antagonism such labors encounter, on various pretexts, many controversies have grown, and in connection with the discussions they have elicited erroneous ideas have been widely disseminated. A large proportion of such disputes would be speedily adjusted if an honest answer was given to the simple question whether it is not a paramount duty to sedulously endeavor to secure just compensation for the use of the money expended in creating railways, and if there was any appropriate application of such an answer to the facts involved in particular cases. It is not uncommon for the legislators of states traversed by lines which have a very light traffic to propose, and even to succeed in passing, laws which fix rates for moving passengers and freight at figures that are too low to permit any line with a small amount of business to earn the interest on its actual cost, and a favorite argument in connection with the advocacy of such measures is that railways of other states or countries which are thickly populated, and furnish a large amount of business, conduct movements at the figures proposed, and that it cannot, therefore, be unjust to require that a line traversing districts in which the number of inhabitants per square mile falls far below the existing low average in the United States shall work as cheaply as the roads which enjoy the benefit of a better location.

It should require little consideration to satisfy any just man that such reasoning is fallacious. When all other things are equal the real cost of transportation is diminished more rapidly by an increase of business than by any other single cause, and while there are various ways in which this diminution of cost, through or by the increase of business is secured, the most important, usually, is the reduction in the average payment for each particular service which is necessary to defray fixed charges. If the interest account of a road, for instance, is $1,000,000, and its business consisted exclusively in moving freight over its entire line, it would be necessary, if only one hundred thousand tons were moved, to secure an average profit of ten dollars for each ton, while if the amount of traffic was increased to one million tons, an average profit of one dollar per ton would be sufficient to defray interest charges. This principle, through many ramifications, is applicable to all railway movements, and upon the degree of fidelity or success with which its obvious teachings can be adhered to or enforced, perhaps more than upon any other single cause, depends the solvency or insolvency of any particular corporation or combination of corporations.

ITEMS OF COST, EXCLUSIVE OF CAPITAL ACCOUNT.

The question has often been asked what does it cost to transport a ton of freight per mile, or a passenger per mile, exclusive of allowance for interest. The true answer, in particular cases, would vary more than the answer to a similar question relating to most any other industrial process. The Massachusetts commission began to grapple with this problem soon after it was organized, and it soon reached the conclusion that "the cost of moving freight varies, under given circumstances, at least as much as the cost of raising crops." Mr. Albert Fink soon after published an elaborate analysis of the cost of moving freight on the main line and various branches of the Louisville and Nashville Railroad, and showed that if allowance was made for the interest of the capital used, the difference in the cost per ton per mile was as follows:—

Line.	Cost per ton per mile. Cents.
Main stem	1.78
Memphis line	2.10
Nashville and Decatur Railroad	2.54
Knoxville branch	4.17
Bardstown branch	7.72
Richmond branch	9.60
Glasgow branch	10.10

He also showed that if due allowance is made for all the circumstances attending freight movements, including those that grow out of the difference between a return load in one instance which cannot be procured in another, the actual cost had varied in the proportion of 1 to 511. This general statement furnishes a remarkably clear indication of the multiplicity and magnitude of the considerations involved. It is more fully explained in the following extract from the report on internal commerce issued by the United States Bureau of Statistics for 1876:—

"The cost of moving freight upon railroads, instead of being a simple question susceptible of a single answer, is one of great difficulty and perplexity. Mr. Albert Fink ascertained that the average cost of transport on the various lines operated by the Louisville and Nashville varied from 1.78 cents per ton per mile to 19.1 cents per ton per mile, and the cost varied widely with respect to the carriage of different commodities on the same road. Mr. Fink also stated that the cost per ton per mile in some instances *did not exceed one-seventh of one cent, and in others was as high as 73 cents per ton per mile*, the latter rate being *511 times greater than the former*, the lower costs applying to freight moved in cars that would otherwise have been empty, and the higher cost to freight in small quantities, carried in the direction of the principal movement."

Mr. Fink also prepared the following statement of the elements embracing, and formula for ascertaining, the cost of railroad transportation:—

MAINTENANCE OF ROADWAY AND GENERAL SUPERINTENDENCE.

Road Repairs per Mile of Road.

1. Adjustment of track.
2. Ballast.
3. Ditching.
4. Culverts and cattle guards.
5. Extraordinary repairs, slides, &c.
6. Repairs of hand and dump cars.
7. Repairs of road tools.
8. Road watchmen.
9. General expenses of road department.
10. Cross-ties replaced, value.
11. Cross-ties replaced, labor.
12. Cross-ties, train expense hauling.
13. Bridge superstructure repairs.
14. Bridge watchmen.
15. Shop-building repairs.
16. Water-station repairs.
17. Section-house repairs.
18. General superintendence and general expense of operating department.
19. Advertising and soliciting passengers and freight.
20. Insurance and taxes.
21. Rent account.
22. Salaries of general officers.
23. Insurance, taxes, and general expense.

Station Expenses per Train-Mile.

24. Labor loading and unloading freight.
25. Agents and clerks.
26. General station expense, light, fuel, &c.
27. Watchmen and switchmen.
28. Expenses of switching.
29. Stationery and printing.
30. Telegraph expenses.
31. Depot repairs.

Movement Expenses per Train-Mile.

32. Adjustment of track.
33. Cost of renewals of rails, value.
34. Labor replacing rails.
35. Train expense hauling rails.
36. Joint fastenings.
37. Switches.
38. Locomotive repairs.
39. Oil and waste used on locomotives.
40. Watching and cleaning.
41. Fuel used in engine house.
42. Supervision and general expense in engine house.
43. Engineers' and firemen's wages.
44. Conductors and brakemen.
45. Passenger-car repairs.
46. Freight-car repairs.
47. Oil and waste used by cars.
48. Labor oiling and inspecting cars.
49. Train expenses.
50. Fuel used by locomotives.
51. Water supply.
52. Damage to freight and lost baggage.
53. Damage to stock.
54. Wrecking account.
55. Damage to persons.
56. Gratuity to employés.
57. Fencing burned.
58. Law expenses.

FORMULA FOR ASCERTAINING THE COST OF RAILROAD TRANSPORTATION PER TON PER MILE, BY ALBERT FINK, ESQ.

Showing, also, with reference to the items of expenditures before stated, the various elements entering into the calculation of cost.

$$\text{Movement expenses per ton-mile} = \frac{\text{movement expenses per train-mile (items 41 to 58)}}{\text{average number of tons of freight in each train}} = a.$$

$$\text{Station expenses per ton-mile} = \frac{\text{cost of handling freight (items 24 to 38) at forwarding station} + \text{at delivery station}}{\text{length of haul.}} = b.$$

$$\text{Maintenance of road per ton-mile} = \frac{\text{cost of maintenance of road per mile per year (items 1 to 23)} \times \dfrac{\text{total miles run by freight trains per year}}{\text{total revenue trains, passenger and freight, per year}}}{\text{average number of tons of freight transported over one mile of road per year.}} = c.$$

$$\text{Interest per ton-mile} = \frac{\text{cost of road per mile} \times \dfrac{\text{rate of interest per annum}}{100} \times \dfrac{\text{number of freight-train miles per year}}{\text{number of revenue-train miles, freight and passenger, per year}}}{\text{average number of tons of freight transported over one mile of road per year}} = d.$$

Total cost per ton-mile $= a + b + c + d.$

In order to make use of this formula, it is necessary to know the fifty-eight items of expense enumerated before, all of which vary on different roads, and enter into different combinations with each other. Some of the items of movement expenses (41 to 58) change with the weight of trains, and have to be ascertained in each individual case. The average cost for the year can be made the basis of the estimate. Besides the items already shown, the following other items enter into the calculation: The average number of tons of freight in train per mile of the round trip of the train; the average length of the haul; the number of miles run over the road, with freight and passenger trains, per annum; the cost of the road; the rate of interest, and the total number of tons of freight carried during a year over one mile of road. Without these data it is impossible to make a correct estimate of the cost of transportation on railroads.

The method of calculation described above is not merely theoretical, but it was, substantially, applied, during a series of years to the operations of the Louisville and Nashville Railway, while Mr. Fink was a leading officer of that road, and the exact results are stated with great precision, in some of his publications. In a general discussion of this subject he forcibly says that "there might be some variation in the cost of manufacturing certain articles, or in raising the products of the soil in different parts of the country, yet they are inconsiderable as compared with the difference that exists between the cost of transporting one ton for one mile on one road and the same service for another, even if such roads are under the same management, and the same scale of prices for material and labor prevail. . . . The different causes which produce differences in the cost of railroad transportation on different roads, or on the same road, at different times, may be divided under the following general heads:—

I. The character of the road.
II. Cost of labor and material.
III. The speed of trains.
IV. The amount and nature of the business of the road.
V. The cost of the road and equipment."

CIRCUMSTANCES AFFECTING COST OF TRANSPORTATION BY RAIL.

A condensed version of a discussion of this subject in an internal commerce report for 1876 embraces the following statements:—

"There are various circumstances affecting the cost of transportation on railroads.

(*a*) *Gradients.*—The gradients of the railroads constituting important highways of commerce differ very much, the maximum being about 125 feet to the mile. Auxiliary motive power is frequently required in order to overcome the heavier grades. Differences of opinion exist as to the effect of gradients of known declivity upon the cost of transportation.

A somewhat generally accepted proposition is that the resistance on a grade of 20 feet to a mile is double that on a level road. The effect of grades upon cost of transportation varies very much on different roads, owing to the different weight of the locomotive employed, the cost of coal, and the magnitude and direction of the tonnage moved.

(*b*) *The cost of transportation on every road is affected greatly by the cost of the road itself.*—Suppose two roads of equal length and having an equal amount of traffic, one of which has cost $20,000,000 and the other $10,000,000. Evidently the traffic on the former road must earn more than on the latter in order to yield the same rate of interest on the investment.

(*a*) *The cost of transportation on railroads is greatly affected by the wages of labor and the cost of material.*—The wages of labor and the cost of material are even 50 per cent. greater in certain localities than in others.

(*d*) *The cost of fuel is a very important element affecting cost of transportation.*—A road passing over coal beds will be able to procure its supplies of fuel at low rates, while the cost of fuel on a road which must pay the expense of transporting coal several hundred miles will be much greater.

(*e*) *The cost of transportation on the more northerly roads of this country is greatly affected by frost and snow.*—No accurate computation can be made of the effect of frost and snow upon the cost of transportation; but careful estimates, based upon the most reliable data which can be procured, indicate that on many of our northern roads the cost of operating during the winter months is from 10 to 25 per cent. greater than during the other months of the year. Great expense is sometimes incurred in removing snow after a severe storm.

(*f*) *Volume of traffic.*—This is the circumstance which perhaps affects the cost of transportation on railroads more than any one which has yet been mentioned. A large amount of freight can be carried at much less cost per ton per mile than a smaller amount. Upon this condition more than upon any other, railroad managers base their general estimates of cost of transportation.

(*g*) *The length of haul or distance which commodities are transported is an important element of the cost of transportation.*—Freight which is carried a short distance is very much more affected by the expenses of handling, warehousing, and billing than freight carried a long distance.

The terminal expenses may be the same for the transportation of goods one mile as for a thousand miles.

(*h*) *Alignment of road.*—A difference of opinion exists among railroad managers as to the precise value of this element of cost, but the general fact is well established that locomotives can haul a greater number of cars on a straight road or on a road having easy curves than on a very crooked road, especially a road which has heavy grades.

(*i*) *The cost of transporting commodities in bulk is less than the cost of transporting them in separate packages.*—The terminal expenses incurred in the transportation of coal, grain, lumber, and cattle are very much less than the expenses of handling and warehousing miscellaneous merchandise. Grain is transferred from railroad cars and vessels into warehouses, and again from warehouses into railroad cars and vessels at a cost not exceeding one-fourth to one-half a cent per bushel. Coal is simply dropped from pockets into vessels or is emptied into vessels or cars by chutes. Cattle are loaded and unloaded with very little expense. Valuable merchandise, on the other hand, involves expensive handling, care in transportation, and risks of various kinds. Besides, it must be carried in expensive cars and be carefully protected in warehouses.

(*i*) *Cost of transportation is less for a regular than for an irregular traffic.*—This is an economic principle recognized in all branches of business. Every railroad company must, under its obligation as a common carrier, provide cars and other facilities for the traffic which may be thrown upon it at the periods when the demand for transportation is greatest. During certain seasons of the year the equipment required to transport the traffic on many roads is three or four times as great as at other seasons. But a road engaged in such an irregular business must keep on hand many cars, and have in its employ a large number of men not required during the months when business is lightest. All these cars, and nearly all the employés whose efficiency depends upon their general knowledge of the particular working of the road, cannot be dispensed with every time the business falls off. This feature of transportation greatly affects the east and west trunk roads, especially in regard to their through traffic. The varying movement of the crops and the fluctuations of commercial operations cause great irregularity in the movements of traffic.

(*k*) *The cost of transportation is greatly affected by the nature and value of freights.*—It is mainly upon considerations of this character that the classification of freights and the different rates for transporting goods of the various classes are based. These classifications are but expressions in practice of the fact that the actual cost of transporting no two different commodities, including the cost of handling, warehousing, &c., is precisely equal.

The cost of transporting goods which are of a perishable or fragile nature, and require great care in handling and moving is greater than than that of transporting goods which are not liable to decay or leakage. The common carrier is required to transport goods of a perishable nature with dispatch, and to provide suitable facilities for handling and transporting commodities liable to be injured.

(*l*) *The cost of transporting traffic at high rates of speed is very much greater than the cost at low rates of speed.*—In the opinion of well-informed railroad managers the rate of speed for freight trains yielding the maximum profit is about *ten miles an hour.* When freight trains are run at the rate of twenty or thirty miles an hour, the increase in the cost of transportation is about in proportion to the increase of speed.

(*m*) *The cost of transportation is less for commodities moved in large quantities than in small quantities.*—A railroad having a traffic of a million tons of a single commodity would, as a matter of economy, be provided with cars and terminal facilities especially adapted to the particular traffic. Full trains could thus be run regularly, insuring the greatest economy of car service, motive power, and wages of employés. This is an economic condition very clearly recognized by every railroad manager.

(*n*) *The cost of transportation is largely affected by the amount of dead weight carried.*—The economy of car service depends largely upon the exigencies of the traffic of a road and the skill exercised in the management of its equipment under the complicated arrangements and combinations which have sprung up between railroads in order to meet the requirements of commerce.

(*o*) *The cost of transportation differs greatly on roads on account of the maintenance of the road itself.*—The ratio which the cost of maintenance of roadway bears to the total operating expenses on several important roads is shown in the following table:—

Roads.	Percentage which cost of maintenance of roads is of total operating expenses. Per cent.
Pennsylvania Railroad	22
Lake Shore and Michigan Southern	25
Michigan Central	12
Louisville and Nashville Railroad, main stem	14.453
Railroads of Massachusetts	24.500
Chicago and North-western Railroad	14.500
Chicago, Burlington and Quincy	25.500

The cost of the maintenance of a road having few bridges and located in a comparatively level country having a sandy or gravelly soil is very much less than of a road built upon a yielding soil and having heavy excavations and embankments and many bridges. This source of expenditure is of course affected very much by the character of the construction of the road-bed and superstructures.

(*p*) Perhaps the most important of all the considerations affecting the cost of transportation on a railroad is *the skill with which it is managed, embracing both the direction of matters of detail and general administration.*

In the management of the great trunk lines connecting the interior with the seaboard this is the consideration of especial importance. In the course of the contests between the trunk lines when competition runs wild, the general administration of the affairs of a road embraces questions of very great magnitude and of national interest. The proper management of these great trunk lines requires executive ability of a high order and an extensive knowledge of the details of transportation and of commercial affairs.

The circumstances and conditions governing the cost of transportation on railroads which have thus far been mentioned may be summarily stated as follows: *First*, gradients; *second*, cost of roads; *third*, the wages of labor and cost of material; *fourth*, cost of fuel; *fifth*, effects of frost and snow, *sixth*, volume of traffic; *seventh*, distance; *eighth*, alignment of road; *ninth*, the distinction as to bulk or package traffic; *tenth*, regularity of movement; *eleventh*, nature of commodities, as to their being perishable or fragile; *twelfth*, speed; *thirteenth*, quantity transported of one kind; *fourteenth*, dead weight; *fifteenth*, maintenance of road; *sixteenth*, skill in management. There are other conditions affecting the cost of transportation, of comparatively trifling importance on certain roads, but of very great importance on other roads."

INFLUENCE OF RAILWAYS ON THE GRAIN AND PROVISION TRADE.

THAT the exports of provisions and breadstuffs, annually pouring forth from seaboard cities, exceed the wildest expectations of old-time Fourth of July orators goes without saying. It is well known that they were a leading cause of the country's recovery from the depression consequent upon the panic of 1873, the prolonged suspension of specie payments, and the efforts to restore them. Yet, striking as is this branch of our commerce, the leading facts attract comparatively little attention. Newspaper orators and magazines are more apt to keep the growth of leading cities before the public, and to publish statistics bearing on the progress of large centres of population, than to direct attention to the expansion of the agricultural interest. Viewed from the true standpoint, however, the growth of many of the rural districts is more remarkable than that of the cities. A seaport, with a good harbor, can hardly fail to gain in numbers and wealth; but it is matter for pride and wonder that the country is dotted with thriving villages, and that myriads of acres, wild and tenantless, at a comparatively recent period, are now under careful cultivation. A prime agent in this great work of developing latent resources has been the railway. Much of the fertile soil, of the west and north-west, would have been of little use had they not been provided with "easy conveyance for men and things from one place to another."

Up to 1824 the cost of moving freight from Buffalo to New York was $100 per ton, but the opening of the Erie Canal reduced the cost about seven-eighths. Comparatively little influence was exerted by the canal connecting lake Erie with the Ohio river. As late as 1851, 97 per cent. of Cincinnati's beef exports, 96 per cent. of corn, and 97 per cent. of flour were shipped down the Mississippi to New Orleans. The river route thus proved fully able to hold its own against canal competition, but what the canal could not effect was an easy task for the railway. Only a small percentage of western produce, bound for a foreign market, now finds its way into bottoms of Mississippi steamers or barges, it being more expedient to forward it to the seacoast per railway. It would be idle to question the great work canals have done for mankind. It would be scarcely less idle to pretend that they cau be seriously regarded as dangerous rivals of the railways. No more striking proof of this could be furnished than that afforded by the desperate endeavors of the English canal companies to overwhelm George Stephenson, and the languid objections made by railway officials to the abolition of tolls on the New York state canals. In the former case the endangered capitalists saw the rising shadow of an all-conquering enemy; in the latter there was simply an inability to perceive why all the citizens of the Empire state should be taxed for the benefit of a mere fraction of the population.

The following figures, taken from the United States census, show the rapidity with which the farming interest has been progressing:—

	1870.	1880.
Total land in farms, acres	407,735,041	536,081,835
Improved land, acres	188,921,099	284,771,042
Total number farms	2,659,985	4,008,907
Farms under 100 acres	2,075,338	2,208,374
One hundred to 500 acres	565,054	1,695,983
Five hundred to 1,000 acres	15,873	75,972
One thousand acres and over	3,720	28,578

Of farms of or exceeding 1,000 acres, Georgia had 902; Alabama, 696; Virginia, 641; South Carolina, 482; Mississippi, 481; Louisiana, 371; North Carolina, 311; California, 262, and Illinois, 194. Statistics bearing on values might prove misleading, as gold was at a premium during 1870.

Comparison of the product of some leading staples shows the following:—

	1870.	1880.
Wheat	287,745,626	459,483,137
Corn	760,944,549	1,754,591,676
Hay, tons	27,316,048	35,205,712
Tobacco, pounds	262,735,341	472,061,157
Butter, pounds	514,092,683	777,250,287
Cheese, pounds	27,772,489	53,492,153

Live-stock returns compare as follows:—

	1870.	1880.
Horses	7,145,370	10,357,488
Mules and asses	1,125,415	1,812,808
Milch cows	8,935,332	12,443,120
Other cattle	14 885,276	23,482,391
Sheep	28.477,951	35,192,074
Swine	25,134,569	47,681,700

It will be of interest to compare with these figures the following data from Poor's Railroad Manual:—

Statement of miles operated, capital stock and funded debt, and dividends paid for ten years:—

Year.	Miles operated.	Capital and funded debt.	Dividends paid.
1881	94,486	$5,010,389,579	$93,344,200
1880	84,225	4,897,401,997	77,115,411
1879	82,223	4,762,506,010	61,681,470
1878	78,960	4,589,948,793	53,629,368
1877	74,112	4,568,597,248	58,556,312
1876	73,508	4,468,591,935	68,039,668
1875	71,759	4,415,631,630	74,294,208
1874	69,273	4,221,763,594	67,042,942
1873	66,237	3,784,543,034	67,120,709
1872	57,323	3,159,423,057	64,418,157

Statement showing the census of the states named therein; the population of the same; the number of miles of railroad in the same; the earnings of such railroads, and the number of bushels of wheat and Indian corn produced in each, in the years 1870 and 1880, respectively:—

States.	Areas.	Population. 1870.	Population. 1880.	Miles of railroad. 1870.	Miles of railroad. 1880.	Earnings of railroads. 1870.	Earnings of railroads. 1880.	Number of bushels of wheat and corn produced. 1870.	Number of bushels of wheat and corn produced. 1880.
Ohio	39,964	2,665,260	3,197,794	3,538	5,912	42,331,733	62,314,749	95,383,303	158,695,925
Michigan	56,451	1,185,059	1,634,096	1,638	3,931	7,900,382	19,297,775	30,086,238	72,381,326
Indiana	33,809	1,680,637	1,978,358	3,177	4,454	19,080,240	31,813,948	78,841,760	164,410,909
Illinois	55,410	2,539,891	3,078,636	4,823	8,163	42,095,227	71,289,545	160,048,799	378,933,350
Wisconsin	53,924	1,054,670	1,315,376	1,525	3,130	7,618,985	15,482,630	40,640,342	60,876,144
Minnesota	83,516	439,526	780,807	1,092	3,107	1,941,716	9,353,889	23,609,240	46,605,401
Dakota Territory	150,922	14.181	134,502	56	1,265	......	......	240,802	5,096,443
Iowa	55,645	1,194,020	1,624,463	2,683	5,235	5,581,646	6,611,435	98,674,559	312,366,968
Nebraska	75,995	122,993	452,432	705	2,000	8,075,277	24,147,262	6,861,746	79,632,316
Missouri	65,350	1,721,295	2,169,091	2,000	4,011	12,865,734	24,085,330	80,350,007	228,436,347
Kansas	81,318	364,399	995,335	1,501	3,439	5,048,610	10,518,145	19,416,723	91,301,970
Total	752.319	12,981,111	17,360,900	22,738	44,647	153,549,360	274,914,708	634,153,519	1,601,737,099

During the ten years from 1870 to 1880, in eleven western or north-western states, including Dakota, the railway mileage increased from 22,738 to 44,647; the production of wheat and corn rose from 634,153,519 bushels to 1,601,737,099, and the value of the total exports of breadstuffs, provisions, and live animals from $102,003,677 to $431,102,262. Of an increase, therefore, of all exports amounting to $443,000,000, $330,000,000 was made up of products of the western or north-western states.

The movement of this vast volume of traffic was attended by an extraordinary lowering of rates. The New York Central and Hudson River in 1855 moved 670,073 tons of freight, at 3.270 cents per ton per mile, and in 1881 moved 11,591,379 tons at .780 cents per ton per mile. The cost per ton per mile of movement for both periods was 1.341 cents, and .562 cents respectively. The Pennsylvania Railroad moved, in 1855, 365,000 tons of freight, at 2.746 cents per ton per mile, and in 1881, 18,229,365 tons, at .799 cents per ton per mile. The cost of movement for both periods was 1.662 and .437 cents respectively.

Statistics presented by Mr. Albert Fink, in his report upon the adjustment of railroad rates to the seaboard, teach the same lesson, viz., that an efficient transportation system is vitally necessary to extensive agricultural operations. In the year 1878, 272,703,841 bushels of grain, including flour, were received at the four ports of New York, Boston, Philadelphia, and Baltimore, and of these receipts 190,361,684 bushels were exported. At New York alone the aggregate receipts were 152,862,170 bushels, of which 63,905,872 bushels came by canal, 85,350,079 by rail, and 3,606,219 by coast. In 1879 the total receipts footed up 310,122,100 bushels, of which 228,065,075 were exported. New York's share of the receipts was 163,124,890 bushels, of which 57,044,406 came by canal, 101,929,243 by rail, and 4,151,241 by coast. In 1880 the receipts were for the four ports 315,932,438 bushels, of which 238,506,441 bushels were exported. New York received 169,092,543 bushels, of which 69,440,901 came by canal, 95,414,822 by rail, and 4,236,820 by coast.

The total receipts of flour and grain at New York, Philadelphia, Baltimore, Boston, and Montreal were as follows: 1865, 93,753,650 bushels; 1866, 97,522,166; 1867, 87,112,779; 1868, 106,769,295; 1869, 118,268,926; 1870, 124,461,841; 1871, 158,805,433; 1872, 170,234,499; 1873, 174,525,321; 1874, 192,452,353; 1875, 179,875,321; 1876, 209,082,401; 1877, 205,420,366; 1878, 293,576,061; 1879, 332,485,424; 1880, 341,349,702 bushels.

As before stated this increase in surplus production and movement was due, in a large degree, to an increase in railway facilities. The number of miles of railway in operation was as follows: 1865, 33,908; 1866, 35,085; 1867, 36,801; 1868, 39,250; 1869, 42,229; 1870, 46,844; 1871, 52,914; 1872, 60,293; 1873, 66,171; 1874, 70,278; 1875, 72,383; 1876, 74,096; 1877, 76,808; 1878, 79,089; 1879, 81,776; 1880, 86,497; 1881, 94,000.

In 1880 the magnitude of the export movement of breadstuffs culminated, through various causes, including the improvement of the crops of competing foreign countries, and in some years the decrease of the surplus products of the United States. This led to a decline in the aggregate receipts of the leading Atlantic ports from the high figures reached that year to 273,042,506 bushels in 1881; 206,162,852 bushels in 1882; 241,617,503 bushels in 1883; 224,314,599 bushels in 1884; 233,162,038 bushels in 1885, and 245,433.815 bushels in 1886. A considerable export trade in breadstuffs and provisions has been steadily maintained.

As mileage expanded freight charges were lowered, the leading railway companies being most active in this work. "It may also be remembered," says Mr. Edward Atkinson, writing in 1881, "that a considerable part of the reduction in cost has been made possible by the substitution of steel for iron rails, notwithstanding the fact that this substitution began when steel rails cost about three times as much as they now do, and was continued for a long period at twice the present cost. . . It cannot be too often repeated that the railway and the steamship have eliminated distance. The western farm and the eastern workshop, the southern plantation and the northern factory, have been brought near each other, and in the process the very lines of railroad that have been most profitable to their owners are the specific lines that have performed the largest service at the least cost to those who use them. One day's wages of a mechanic in Massachusetts will pay the cost of moving his year's substance of bread and meat one thousand miles, from Chicago to Boston." Mr. Atkinson further says, in words as true to-day as when they were written: "May we not dread the attempt of state legislatures, and of Congress, to alter these conditions by meddlesome statutes, and to prescribe rules for the conduct of this vast and varied service? If either body were to attempt to regulate the production of the farm by statute, who would be more quick to resent the interference than the farmers themselves? But the farmers derive their titles to their lands from the same source that the railway owner holds the title to its track. They are no more producers than the common carriers are; they move the soil with their machines; they move the seed; they move the crop on their wagons to the mill and to the market. All that the railroad does is to keep the product moving. One is as much under the supervision of law as the other, but if the work of either could be regulated by statute with success, it would be the simple work of the farmer and not the complex work of the railroad."

In speaking of the movement of food supplies Mr. Atkinson says that "if the wheat be traced throughout its course the heaviest single charge upon it will be found to be the cost of distributing the loaves of bread that come from the baker's oven; the lightest the charge for moving the barrel of flour a thousand miles from Chicago to the seaboard."

POPULAR COMPLAINTS AGAINST RAILWAYS.

A COMPREHENSIVE history of popular complaints and grievances against railroads and anti-railroad agitations would be almost equivalent to a history of railroads themselves. The first epoch of railroad history in many sections of the United States was usually marked by an almost universal popular desire to encourage construction, extension, and development, to afford every inducement and to express in every way the popular desire for and appreciation of the railroad. Simultaneously with the commencement of operations was the commencement of popular complaints and declarations of grievances. Inherent in the railroad system are the causes which have led to complaints in every community in which railroads have been operated. Until the railroad was constructed the unanimous voice of the community was usually in its favor. The moment it is secured, the advantages are more or less lost sight of and the discussion of grievances begins.

The earliest local roads afforded comparatively slight opportunity for popular grievances, being organized generally under state laws, fixing rates in a manner that prevented the class of discrimination which has been made a fruitful cause of complaint. Even in reference to the earliest roads, however, complaints were made of almost every detail of management.

With the organization and active operation of the trunk lines commences the history of popular agitations of grievances growing out of discriminations, local and personal. Twice of late years committees of the United States Senate have conducted far-reaching investigations of railroad matters, and been overwhelmed with complaints from every section of the country and from representatives of almost every interest. In each case the protests and appeals have been bitter and vindictive, and hundreds of individuals have come forward to declare their grievances. In almost every state, at some period, anti-railroad agitation has played an important part in legislation and in local politics. In many states it has been reflected in state constitutions. The granger movement represents, perhaps, the most fully organized anti-railroad agitation, but scarcely less violent have been similar movements in the south and in portions of the Middle and New England states.

Before the Senate committees on transportation routes to the seaboard and on interstate commerce, when engaged in investigating popular grievances against the railroads, witnesses have stated in general terms that their experience led them to believe that, at various periods, throughout the country there was a widespread popular feeling of opposition to the railroads; that business depression and reverses of all kinds were indiscriminately charged to the influence of railroads; that extortion and unjust discrimination were regarded as the rule rather than the exception, and that the public considered that in a great measure the interests of the railroads were opposed to its own. These witnesses have added that the feeling described was most general among those who know least of the operations of railroads.

The experience of any one in the United States would illustrate in a striking manner how general and earnest have been the popular complaints, and to how great an extent they have been unjust or the result of misinformation. So various have been the criticisms of railroads that it is almost impossible to sum them up. A recent writer on railroad subjects says that "the discrimination between through and local rates has been the subject of the fierce struggle between railroads and their patrons for many years. On the one side were ranged the business community, the manufacturers, the agricultural population of the great western states, and all who believed that high rates of freights were destroying their business. Opposed to them were those whose pecuniary interests were derived from investments in railroad property, the value of which was shrinking from diminished commerce and exposure to excessive and unregulated competition. Down with railroad monopoly! became the battle cry, and the granger movement took its place among the political issues of the day. The battle is still raging as fiercely as ever, and represents the principal cause of all anti-railroad agitation."

Apart from this, the grievances have been as numerous and varied as can well be imagined. Wherever railroads have attained any degree of financial success, some of their patrons have declared that charges were excessive. The discriminations that are inherent in the railroad system, and essential to its practical operation, have everywhere been resisted by those who were not directly favored. Stock watering in all its various phases has been the subject of bitter opposition. Railroads have been accused of controlling legislation, corrupting the press, and influencing elections. They have almost everywhere been charged with extortion. Nearly every detail of their management has been arraigned.

Perhaps there has been no more comprehensive effort, within the borders of a state, to ascertain the popular feeling in regard to the railroads and the nature of popular complaints against them, than was made in 1879 in the state of New York by a committee of the legislature, in response to complaints from commercial bodies and individuals in various portions of the state. This committee devoted some months to taking testimony and listening to all who cared to make known their grievances. William D. Shipman, of counsel for the New York, Lake Erie and Western Railway Company, in an argument before this committee, summing up the grievances which had been stated, alleged that efforts had been made to hold railroad companies responsible for all the vicissitudes of business of whatever nature and whatever might be their true causes. The complaints were of the most varied character. It was charged that the railroads were capitalized on a basis of two dollars to every one actually paid in providing facilities, and that they could be constructed for one-third of their nominal value; that combinations and pools, by which the public suffered, were necessary to their profitable conduct, even with honest management; that in too many cases the interests of stock and bondholders were subordinated to those of the managing ring, who purposely and dishonestly depleted the revenues, so that a majority of the *bona fide* owners got nothing. It was alleged that the railroads of New York were in the habit of discriminating in favor of citizens of other states and of foreign countries to the prejudice of the interests of the people of New York; that individual citizens were given special privileges and rates out of proportion to those charged to the public in general; that the rates of transportation were made unnecessarily high by the maintenance of subsidiary organizations designed to deplete the revenues of the roads before profits reached the stockholders; that fast freight lines, bridge companies, live-stock companies, local lines, leased at exorbitant rates, stock-yard companies, construction companies, elevator and other terminal facility companies, were maintained improperly at the expense of the great roads, and corruptly used to promote the financial interests of members of the managing ring; that the rights of stockholders were in every respect and in the grossest manner disregarded; that the classifications of freight abounded with unjust, unfair, and unreasonable features; that New York city suffered by the differential charges allowed on the traffic of Baltimore, Philadelphia, and Boston; that the tendency of railroad management had been to divert trade from the metropolis, and that there was ground for fear that the railroads would be instrumental in carrying a great portion of New York's trade to other cities. The great pooling agreement of 1877 between the four trunk lines was the subject of innumerable complaints of discrimination and extortion.

Vigorous protests came from the milling interests of Rochester; from the grain dealers, pork packers, and shipping interests of Buffalo; from the shippers of cattle and produce and from the owners of agricultural lands. The railroads were charged with depreciating the value of farms, and with injuring by unjust and unreasonable prices almost every interest of the state. One source of complaint was the large salaries paid to railroad officials. Another, the rapid accumulation of wealth by some railroad magnates. Another, the abuses growing out of the issue of free passes. Complaints were directed to almost every conceivable feature of railroad business.

The investigation, extending over nearly a year, was scarcely necessary to prove that many of these complaints related to matters for which the railroads were in no respect responsible, which were due entirely to other causes, and that many of the grievances were entirely imaginary. It was at the same time demonstrated that there were some grave causes for complaint, and that some of the criticisms made were well founded. The committee denounced what was complained of as the oil monopoly in unmeasured terms; reported that stock watering had been practiced to a criminal extent; laid stress upon the corrupt influences wielded by the railroads, and reported that the discrimination practiced involved much injustice and many abuses.

In Pennsylvania the anti-railroad feeling has at times assumed considerable bitterness. The popular expressions, legislative enactments, and public declarations have reflected to a greater or less extent nearly all the grievances complained of in other states. Gov. Pattison, in his inaugural address, in 1883, declared that there was no more important duty awaiting the legislature than the regulation of railroads in the interest and for the protection of the people. He alleged that the railroads had violated provisions of the state constitution constantly, defiantly, and flagrantly; that the people were entitled to have at least a fair trial made of their ability to bring the vast corporations that they had created and fostered, under their just regulation and control. The constitution and the people demanded that corporations should act justly and treat all the people alike with uniform fairness and impartiality; that unjust discrimination against persons or places should be prohibited and extortion forbidden; that powers conferred by the people, and subject to the regulation of law, should not be used to harass and oppress; that much was to be done in the way of legislation to prevent the power of corporations from becoming too vast and irresponsible; that the railroads had outgrown the most sanguine expectation in their development, and had introduced new evils as well as new benefits; that their influence had extended into almost every department of business and of life, not only affecting the centres of money and of trade, but the minutest affairs of individuals; that thousands of laborers looked to them for employment, and depended alone upon their determination for the measure of hire; that the price of the necessaries of life were often regulated by their will, and that all of this was an exhibition of power not contemplated in their creation, the existence of which in any combination of men was to be deplored and, if possible, prevented, or at least regulated and controlled. Something had to be done to bring into proper regulation the corporations of the country, and adjust upon a fair and reasonable basis the combinations between those objects of the bounty of the state and the people.

About this time Judge Jeremiah S. Black was voicing the anti-railroad sentiment in more violent terms. He alleged the existence of a combination between the great trunk lines to stop all competition, to unite the power of all into one grand monopoly, and to put the whole people at their mercy. This he described as a criminal conspiracy, and declared that where such a combination existed the railroads victimized the people remorselessly. The extravagant and discriminating charges prevailing he declared to be a fraud upon the charters of the roads themselves as well as a gross wrong to the victims. The little finger of monopoly, he said, had become thicker than the loins of the law; the influence of the railroads over the legislature mysterious and incalculable, and strong enough to make the constitution a dead letter, in spite of oaths to obey it and the popular demand, almost universal, to enforce it. For every millionaire that the railroads had made, he said, they had made 10,000 paupers. Judge Black alleged that local and personal discriminations were almost universal and were far-reaching and grievous in their burdensome effects.

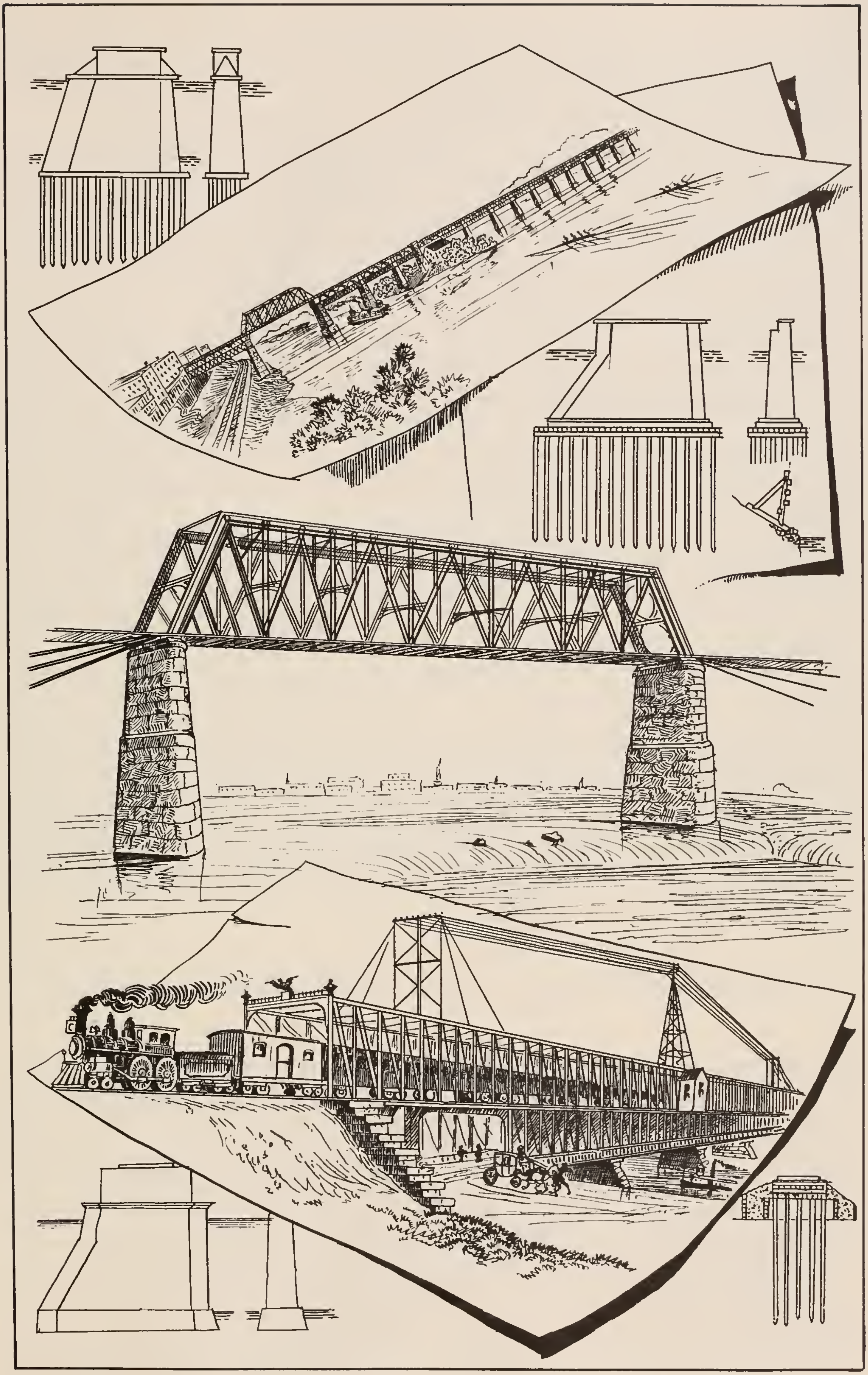
In the south anti-railroad legislation had no lack of early and earnest exponents. One of the leaders in 1879 declared that the attitude of the trunk lines to the public was most extraordinary. They were pitted against the public whose interests were being sacrificed to their own, and the conflict was irrepressible. In each of the southern states, early in the history of through railroad systems, popular grievances had become well defined and loudly expressed.

Anti-monopoly organizations, formed in various states, and at some periods claiming affinity with a national combination, have declared in violent terms against alleged impositions inflicted by railroads upon the people, and demanded that remedies should be applied. The states which did the most to hasten and induce railroad building, without imposing any regulation or any limit to the power of the companies organized, were the first to complain of the power wielded by the corporations, and in almost every instance the most extreme efforts to induce railroad construction were followed by the most violent revulsion of anti-railroad agitation.

Governor Glick, of Kansas, voiced the sentiment of the anti-monopoly party of his state, and some others, when urging that the first movements of consolidation among railroads had done away with wholesome competition and all fair and generous treatment of the public, and that an epoch had followed during which public interests were shamefully sacrificed. From the time of consolidation an antagonism between the people had steadily increased until the spectacle was presented of rich, strong, influential, and solidified monopolies greedily encroaching upon the rights of the people, whose creatures they are, and to whom they owe not only their existence, but the very patronage which enables them to wield the power whose possibilities are simply appalling. He declared that they had taken advantage of the necessities of business and commerce. They had, upon the flimsiest pretexts, presumed to do high-handed and outrageous things. They had ignored the real interest of the state. They had simply used the state and its resources to the detriment of its agricultral, commercial, and manufacturing interests, so that by a systematic method of pooling their earnings, by unjust discriminations against localities and individuals, by excessive and exorbitant freight and passenger rates, by drawbacks, corruptly allowed, they had wrought injustice and fraud in all their forms upon all classes of citizens. Governor Glick alleged that the result of this had been to make it unprofitable to develop the manufacturing resources of the state of Kansas; that manufactured goods of all kinds made in far eastern states were brought into that state and sold at less cost than those articles could there be manufactured, for the simple reason that railroads were constantly discriminating against home manufacturers, and exacting excessive local rates under the fallacious plea that a long haul was more profitable than a short one. He contended that if the wrongs perpetrated against the agricultural interests of the state, mainly in consequence of the pooling arrangements, were not speedily obviated the farmers would be placed in a condition of helpless submission and dependence, and the agricultural interests virtually abandoned. The growth and prosperity of towns, villages, and cities were checked by railroad abuses; their business, their industries embarrassed; their development rendered expensive and difficult, and the price of commodities unduly enhanced.

On the Pacific coast the anti-railroad feeling has, perhaps, at times attained the greatest virulence, and been expressed in the most unmeasured and ill-considered terms in state legislation and constitutional provisions. No state in the Union has gone further than California in voicing in its state constitution this anti-railroad feeling. The grievances were mainly unjust discriminations and extortionate charges.

In many of the states the anti-railroad feeling has found such violent expression as to react upon the leaders and to bring about considerable revulsion of feeling. Many of the states have inserted in their constitutions, or made a part of their code of laws, severe restrictions or burdensome requirements which there has never been any serious attempt to enforce, and the impracticability of which has been conceded. In the west and south a vigorous popular reaction set in to



OHIO MISSOURI, AND MISSISSIPPI BRIDGES

curb anti-monopoly warfare and anti-railroad movements, which, by embarrassing or crippling railroads, imposed new burdens upon the people.

THE RAILWAY RIOTS OF 1877.

One of the outgrowths of protracted ill-feeling in various communities against railways or railway management, combined with the discontent of several classes of railway employés on account of changes in methods of making train movements or reductions in wages or aggregate compensation, was the railway riots of 1877. Public sentiment then favored the idea that any position assumed by the railway companies in a controversy with men in their service was necessarily wrong, and that the only true end of a railway strike must be the triumph of the strikers. This delusion was only dispelled by the deplorable results of one of the most alarming and destructive demonstrations that ever occurred in this country. The scene of active demonstrations extended over a large part of east and west trunk-line territory and adjoining regions. The incidents included the total suspension of railway movements and enthronement of anarchy for a brief period, the destruction of a large amount of valuable property and loss of a considerable number of lives. A similar demonstration was made in the early portion of 1886, which was specially directed against lines belonging to the Missouri Pacific system; and it also caused, for a time, a total cessation of train movements over a large amount of mileage.

A leading cause of the prolongation of disorders that had a ruinous effect on all legitimate interests was the unwillingness of local authorities to promptly and efficiently perform their appropriate duties, and this unwillingness was generally due to a belief that the communities concerned sympathized with the rioters, a belief which was generally correct, until painful experience showed the necessity of maintaining law and order in defence of the rights of railway companies.

In the outbreak of 1877 Pittsburgh was the scene of the most violent and destructive demonstrations. The first active hostilities, however, probably occurred at Martinsburg, West Virginia, where some blood was shed on July 17th, and as the citizens and local authorities refused to aid in restoring order, the Governor of West Virginia and the president of the Baltimore and Ohio telegraphed to Washington the following day for Federal troops. July 20th witnessed a sharp struggle between the rioters and the militia in Baltimore, and at several points in Maryland there was more or less trouble, while at Pittsburgh rioters began to threaten the Pennsylvania with as much fury as their compeers in a more southern latitude were threatening the Baltimore and Ohio. At Newark, Ohio, an engineer was seized and lifted off the locomotive he was attempting to run. By this time the state authorities of Pennsylvania, New Jersey, Ohio, Indiana, Maryland, and West Virginia were alive to the menacing dangers. On July 21st a detachment of Philadelphia militia arrived in Pittsburgh. During the afternoon several conflicts occurred with a mob, and the casualties were as numerous as those of a sharp skirmish in war times. Maddened by the destruction of the lives of friends and associates, and emboldened by a mistaken military movement, which was regarded as an evidence of timidity, the crowd commenced on the night of July 21st to burn and destroy all the fixed and movable railway property within their reach at a point where a vast amount of it was concentrated. On the following morning, Sunday, July 22d, nothing but a mass of ruins was left where, on the day before, there had been a large number of cars containing valuable freight, together with all the shops and appurtenances necessary to conduct business at one of the most important of railway stations. The rails of thirty miles of adjacent tracks had been so much injured and distorted that replacements were necessary. Repair shops, round-houses, 125 locomotives, car shops, blacksmith shops, machine shop, a lumber yard, the transfer depot, and the Union depot and hotel were all consumed.

After the tiger was let loose in Pittsburgh vigorous attempts to inaugurate similar scenes of destruction at various other places were made. Subsequent developments strongly indicated that professional anarchists took a leading part in inciting sundry mobs to overt acts.

By this time the whole country was in a ferment, and event followed event like a series of electric shocks. The New York Central, by taking wise precautions, suffered comparatively little inconvenience, and in Virginia the railway employés expressed a desire to remain on friendly relations with the companies. Towards the end of the month two Kentucky companies rescinded orders of reductions in wages, and similar manifestations in Canada, portions of Pennsylvania and the southwest, lent new courage to the strikers. By the end of July, however, the strike was practically at an end. Millions of dollars worth of property had been destroyed, not a little blood had been spilt, and assuredly no benefit had resulted to the strikers. The little girl who inquired what good came of the battle of Blenheim, might have asked the same question with regard to the strike of 1887. A terrible lesson was taught, but at times there is fair reason for doubting whether it has not been forgotten. The establishment of the principle that communities must pay damages if they suffer railway property to be destroyed by mobs will probably do much to restrain violent demonstrations.

RAILWAY REGULATION BY LAW AND COMMISSIONS.

A RECENT writer on railroad subjects has said that the birth of the locomotive has brought into existence four classes of questions with which the engineer, the railroad manager, the political economist and the statesman are called upon to deal, and, he might have added that, while the engineer and manager have increased their work to such magnitude, and conducted it with so much skill that all the world wonders, the political economist is still groping in the dark, and the statesman has made little or no progress in solving such railroad questions as come legitimately within his sphere.

The earliest chapters of the legislation affecting railroads in this country usually represent the efforts of states and localities to open the way for railroad construction and to facilitate it by every possible form of encouragement, and the removal of every obstacle. These early specimens of railroad legislation appear to be prompted only by the fear that railroads could not be built with sufficient rapidity and to aim only at the removal of obstacles and the presentation of such inducements as legislative bodies could offer.

Many people have believed that the recklessness of this early legislation in the north-western states was responsible in great measure for the reaction that followed.

The first efforts to apply legislative regulation and restrictive force or supervisory power, like most of those which have followed, were comparatively crude, useless, or meaningless. In some cases the efforts at regulation were made in almost total ignorance of the business and conditions to be dealt with, the laws of trade, and the essential principles of transportation. They aimed mainly at the restriction of dividends, the collection of information, publicity in certain matters of management, or supervision of the physical and mechanical features of the roads with a view to the prevention of accidents.

Some of the earlier as well as later commissions were designed to aid in the enforcement of legal methods of regulating rates by prescribing maximum charges, establishing *pro rata* or equal mileage rates, or endeavoring to prevent railroads from reaping larger profits from one class of traffic than from another, or from one set of shippers than from others. These attempts were usually unsuccessful. Ill-judged interference generally made itself disastrously felt, and the people, as well as the railroads, suffered from the crude provisions to such an extent that the laws were ultimately repealed or ignored.

Later in the history of railroads the demands for railroad regulation, and for protection against extortion and unjust discrimination, arose in a great measure from commercial conditions for which the railroads were not responsible. Whenever the popular hostility to railroads assumed formidable proportions, and led to stringent regulation, the laws of trade ultimately interfered and nullified these enactments as impractical and injurious, even where they were sustained by the highest legal tribunals. The history of railroad restrictive legislation comprehensively reviewed has been that of unpretentious beginnings, yielding in many states to unreasonable requirements, dictated by ignorant hostility, and which in turn proved destructive to the very interests which they sought to benefit, and gradually gave way to more moderate and conservative legislation, which may still be said to be in an experimental state, and which has, upon the whole, been the cause of about as much dissatisfaction as the abuses which it aimed to correct.

As early as 1845 New Hampshire provided for the appointment of an official charged with the collection of information respecting the railroads and the study of the general subject of the relations of the railroads to the state. By 1855 New York, Connecticut, and Vermont had taken similar action. In 1858 Maine made the experimental appointment of a railroad commission, and in 1869 Massachusetts established a railroad commission which proved permanent in form and is regarded as the pioneer of successful state commissions, and the pattern of that type of commission which depends for its power upon its influence with the legislature and upon public opinion.

Taking the states in their alphabetical order, Alabama has a commission of three members appointed by the Governor for two-year terms which has been in existence since 1881. Arkansas confers part of the duties of a railroad commission upon her tax assessors. California, in 1880, instituted a board of three commissioners elected for four-year terms. Colorado, in 1885, provided for one commissioner of railroads appointed for a two-years term. Connecticut, in 1853, instituted what is now a commission of three members, appointed by the Governor for three-year terms, and paid by the railroads. Georgia, in 1879, organized her commission of three members, appointed by the Governor for six-year terms. Illinois, in 1871, started a commission of three members, appointed by the Governor for a term of two years. Indiana entrusts her railroad matters mainly to her tax board. Iowa, in 1878, organized her commission of three members, appointed by the Governor for three-year terms. This, like most of the present commissions in states in which the granger movement achieved great influence, takes the place of more radical and despotic modes of railroad regulation which preceded it, and proved unsatisfactory and injurious. Kansas, since 1883, has had a commission of three members, paid by the railroads. Maine has a commission of three members, appointed for a term of three years and paid by the railroads. Massachusetts, since 1869, has maintained her commission of three members, appointed by the Governor for three years and paid by the railroads. Michigan, in 1873, originated the office of railroad commissioner, appointed for a term of two years. Minnesota, in 1873, elected a board of three commissioners. Mississippi, in 1884, appointed a commission of three members, for a term of two years. Missouri organized a commission of three members with six-year terms in 1875. Nebraska constitutes the principal state officials, with a secretary from each congressional district, as a railroad commission. New Jersey entrusts such railroad regulation as she attempts to the state board of assessors. New Hampshire maintains her commissioner, elected for a term of two years, and compensated by the railroads. New York, after an early and ludicrously unsuccessful experiment with a state commission, organized a new commission in 1883 with three members, appointed by the Governor. Ohio, since 1867, has had a railroad commission appointed for two-year terms. In Pennsylvania the department of internal affairs discharges some of the functions for which many other states have provided special commissions. Rhode Island, since 1872, has had a railroad commissioner appointed annually. South Carolina, since 1878, has maintained a commission of three members, appointed for six years and paid by the railroads. Tennessee instituted a railroad commission, but the powers conferred upon it were pronounced unconstitutional. Texas leaves the administration of state authority over railroads to an official known as the state engineer. Vermont, since 1855, has had her railroad commissioners, appointed every alternate year. Virginia, since 1877, and Wisconsin, since 1874, have had an official appointed for a term of two years, entrusted with some supervisory power in regard to matters of transportation.

The general tenor of events goes far to justify the statement that the advisory commissions have been most successful, and the only ones by which important results have been attained.

All state railroad commissions in the United States have been, to a greater or less extent, patterned upon the law of 1846, establishing the railroad commission of England, and twenty-eight states now have legislation in some respects resembling English law, as from time to time amended. The resemblance to the English law is in no case very great, but it is generally recognized that all the American legislation has been based upon its general principles.

Even in their earliest forms state railroad commissions varied widely, and those now in existence are as diverse as possible in authority, aims, and functions. Following the example of Massachusetts, Connecticut, Iowa, Maine, Michigan, Minnesota, New Hampshire, New York, Ohio, Rhode Island, Vermont, Virginia, Wisconsin, and some other states have established commissions of limited authority, and more or less advisory in their character, depending mainly for their powers upon public opinion and the state legislatures, acting more or less as arbitrators between the people and the railroads, and as investigators and advisers aiming to point out desirable changes of management or methods, improvements or introduction of new devices, and appealing to public opinion and the state legislatures to sustain their decrees when the railroads did not voluntarily accept them.

The commissions of this character have attained so much success in some instances, and failed so completely in others, as to demonstrate that the system is not in itself effective, but depends largely upon the men selected as commissioners, the manner in which they perform their duties, the state of public feeling, the conditions encountered, &c. California, Georgia, Tennessee, South Carolina, Illinois, Kansas, Kentucky, Missouri, and other states have experimented with commissions upon which greater power and authority were conferred. In California and Georgia the supervision has amounted almost to state control, while in the other states regulation of rates and stringent restrictions of various kinds have been attempted. Much less success has been attained than by the advisory commissions, and in some instances complete failure has resulted, and been followed by the abandonment of what was first attempted, and the substitution of more reasonable provisions.

The efforts at railroad regulation by law prior to the war were scattered through several of the states, and were varied in character, but little authority was assumed in any case, and so little accomplished that these early efforts are scarcely entitled to consideration. The first commissions were entire failures, and the Massachusetts commission, instituted in 1869, is generally and justly regarded as the pioneer of the present widespread system of state commissions and boards.

New England was earliest in the field in the effort to secure by legislative enactment restrictive influence over railroad operations. Most of the New England states tried early experiments, but none except Massachusetts attained any measure of success, and the other commissions have been recently reorganized, their functions and powers readjusted, and are still in experimental stages. The Massachusetts commission holds a place in the front rank as in many respects the best and most successful of the state commissions, although it has committed grave errors, which have subsequently been frankly acknowledged. The commission is by law given little actual authority and power. Its functions are chiefly advisory. It investigates, considers, studies, and reports. It announces its conclusions to the public, and submits its recommendations to the legislature. Massachusetts had been fortunate, however, in securing as commissioners men who commanded the confidence of the community, and the respect of both the railroads and those who make complaints against them. The character of the men, their sincere purpose to promote the interests of all concerned, and the well-organized and established conditions existing in Massachusetts have afforded a much greater measure of success for the Massachusetts law and commission than has been attained by similar efforts elsewhere. This commission has attained considerable success in the discharge of its functions under the police power of the state, in compelling repairs and improvements of bridges, road-bed, and rolling stock; the adoption of precautions for the safety and comfort of passengers, and perhaps even more prominently in bringing about the adoption of uniform methods of keeping accounts.

These efforts have oeen imitated with varying degrees of success by the commissioners of some other states. The Massachusetts commission has, as a rule, been sustained by the legislature, and that body has frequently declined to interfere in railroad matters otherwise than upon the recommendation of the commission. The long- and short-haul clause, which has been enacted by several of the states, and ignored in nearly all of them, has been enforced in Massachusests more successfully than in any other state. In regulating rebates and special rates, preventing discriminations injurious to local traffic, and compelling discriminations based on quantity when they were deemed desirable, this commission has exercised considerable influence.

It was, however, the granger movement that brought railroad regulation prominently to attention as a subject for state legistion. This movement served to bring the anti-corporation, anti-monopoly, anti-railroad feeling into full force and promi nence, to voice all grievances, and to promote such hostility as dictated severe and ill-considered restrictive legislation. Although associated most directly with a group of states its influence spread everywhere and its effects were everywhere more or less felt. The history of this movement is elsewhere traced. It excited in many states a feeling of hostility based upon conditions for which the railroads were only partially responsible, and prompted ill judged efforts at railroad control by legislative enactment, fostering a disposition to regard all organized capital as a public enemy and railroads as public oppressors.

As early as 1870 Ohio, Illinois, Iowa, Minnesota, and Wisconsin commenced to respond with stringent legislation, culminating in the so-called Potter law, and aiming by various provisions to curtail railroad earnings, regulate charges, and obviate causes of grievance and complaint. Whenever the granger movement became potent in power the restrictive and regulatory legislation became unreasonably and disastrously severe and stringent, and after a long and bitter contest, continuing for years, these enactments gradually reacted upon their authors, proved their lack of merit or wisdom, and were undone in obedience to the commercial laws which they had defied. The more radical features of the granger laws and much that was attempted by the commissioners created under them proved impracticable.

Throughout the south motives and grievances more or less similar to those underlying the granger movement led to the formation of commissions and enactment of laws which in many cases confer great power and embrace stringent provisions. In some instances a measure of success has been attained in the south by commissions based upon principles which proved unsatisfactory and injurious in the north and west.

The conditions encountered differ in many important respects, and the south has profited comparatively little from the experience of other states, and has experimented for herself in the matter of railroad regulation by law, at great cost in many instances, to the welfare of her people, but with greater success perhaps, in the main, than has been secured by the railroad legislation of other groups of states.

The Georgia commission, perhaps, went to a greater extreme than any other in regulating rates, controlling the details of railroad management, and exercising far-reaching and despotic authority. The state constitution conferred power to regulate railroad freight and passenger tariffs, to prevent unjust discriminations, to require reasonable and just rates, and to punish all violations by severe penalties. This authority was conferred upon the general assembly, and by it upon the commission. The commission appointed consisted, as required by law, of three members, one experienced in the law and one in practical railroad business. The despotic power conferred upon this commission extended to every branch of railroad management, and the early reports of the commission express the apprehension that the duty and responsibility imposed were so onerous that they were fraught with serious difficulty and danger.

The authority of this commission, as has been said, was to prevent extortion and unjust discrimination; to make and enforce reasonable rates, rules, and regulations; to revise all agreements; to examine the condition and operation of the roads, and virtually to enforce all conditions which it deemed to be in the interest of the public as against improper requirements, neglect, or unreasonable demands on the part of railroads. The commission, self-confessedly oppressed by its sense of responsibility and great power, began its work amid legal fights to enjoin. It at times attained a fair degree of popular acceptance, but from the beginning the difficulties encountered were so serious and the powers exercised so questionable that reaction was the natural consequence, and the commission was eventually shorn of its power by the legislature, and there is now a popular feeling of dissatisfaction with the consequences of this artificial restriction.

Following the example of Georgia, South Carolina and Tennessee have experimented with very stringent provisions, but South Carolina speedily became aware of the inexpediency of what had been attempted, and repealed the most unreasonable features after one year's trial, while in Tennessee, after a prolonged contest, the commission and the law under which it was established were declared to be in violation of the national and state constitutions, and were virtually abolished. The effects of the Tennessee experiment had been so clearly prejudicial that little regret was felt at its overthrow.

Alabama has pursued a more conservative course, but even in that state long and bitter contests have ensued in which public opinion has been divided, and considerable disturbance of business has been occasioned. In recent arguments before the legislature it has been alleged that the policy pursued by the state in railroad legislation has been equivalent to building a Chinese wall around the state and injuriously affecting every interest; that the law aimed mainly at imaginary evils, opened the door for every form of black-mailing at the expense of the railroads, led to unnecessary litigation, interfered with business and discouraged the operations of trunk lines, which were necessary to the welfare of the state. The commissioners have, however, been men of considerable force, and have maintained the support of the people in some fierce struggles with the railroads.

Many of the leading southern journals have protested vigorously against the evils and errors of southern state railroad regulation, and in some instances the reaction has been strong enough to bring about radical modifications. Representative southern men have protested that stringent and unreasonable railroad restriction deprived the south in many ways of sources of prosperity to which it was naturally entitled, and which it would have enjoyed under conditions natural and unrestrained. While it is often claimed that the southern commissions have attained the greatest degree of success, the study of their history cannot fail to show that they have done much harm and provoked much popular opposition. In Texas the protest against injurious railroad legislation has recently been very emphatic, and quite generally throughout the south a similar tendency was developed.

On the Pacific coast unreasoning anti-monopoly agitation exercised perhaps the greatest influence on railroad legislation, and in the state of California the highest pitch of anti-cheap-labor, anti-Chinese, anti-corporation, and anti-monopoly excitement dictated a state constitution which in its anti-railroad features was unique in its extravagance, its disregard of property rights and fundamental principles of state authority, of common justice, and all the demands of trade. The constitution conferred the right to appoint a commission clothed with the most despotic powers, and by legislative enactment this commission was given complete control of all railroads in the state, authority to prohibit discriminations of all kinds, to prevent pooling and the increase of rates which had once been reduced for purposes of competition, and the specific regulation of all rates and charges. The provisions of law and the decrees of the commission were such as to bankrupt the railroads if they had been accepted, and as a consequence they were defied. The commission soon came to be regarded as a failure, and little of the work for which it was appointed was carried out. The state constitution provided that the state should not be a stockholder of any corporation; the stockholders were made individually responsible for debts and liabilities, and trustees and directors were individually liable for all moneys misappropriated or embezzled during their terms of office; corporations were forbidden to engage in any other business than that named in their charters, and stock-watering was stringently prohibited; the railroad companies were compelled to keep their books open for inspection; railroad employés were prohibited from having any interest in furnishing supplies to the company by which they were employed; railroads which lowered their rates were prohibited from raising them; *pro rata* equal mileage rates were exacted; free passes or special rates were prohibited, and discriminations of all kinds declared illegal; to the commission was intrusted the power to establish freight and passenger rates, to examine books, to hear and determine complaints, to prescribe a uniform system of accounts, and for the violation of the provisions of this regulatory legislation fines of $20,000 for each offence were provided, with fines of not less than $5,000 or imprisonment for officials offending. In addition to all this, provision was made for heavy damage for individual grievance, and the legislature was given general power to increase the stringency of anti-railroad legislation as it might deem necessary.

The California commission, with its despotic and comprehensive powers, was so entirely unsuccessful as to afford a striking example and warning for all time to come.

The Colorado commission was established in consequence of complaints of alleged abuses by the Union Pacific Railroad, but, as was the case in the western states, the bounds of prudence and wise regulation were overstepped, the great laws of trade were disregarded, and popular sentiment declared the legislation and the assumed regulation to be detrimental to the widespread public interests dependent upon the prosperity and extension of the railroad system.

In Iowa different conditions have been encountered, and a very fair degree of success attained by the commission appointed in 1878, to succeed one of the most stringent and most signally unsuccessful commissions which grew out of the granger agitation. The commission has comparatively slight powers, which have, as a rule, been wisely and beneficially exercised.

Governor Geer, in commending the new commission as a useful and efficient one, took occasion to say that the previous board and the legislation under which it acted checked the development of the railroad system of the state, and injured the material interests and welfare of the commonwealth by its stringent, arbitrary, and oppressive character. Iowa suffered severely for her experiment with granger railroad law.

Wisconsin paralleled the worst features of the Iowa law, and was disturbed for some years by bitter legal contests between the railroads and the people, and by much obstruction of trade and interference with the industries and interests of the state.

Minnesota revived promptly and prosperously after the first granger movement had reigned and fallen, and substituted for its unwise code a simpler and more just system of railroad regulation, but subsequently passed a law containing many obnoxious features.

Ex-Governor Marshall, as railroad commissioner of Minnesota, a few years ago declared in defence of his own cause, that the provisions then in force were a total abandonment of all the principles of the granger movement; that they authorized no attempt to fix rates, no provision for the institution of suits in the name of the state, and no imposition of heavy fines.

While not blind to the evils existing in the railroad system, the commissioner declared that they are largely incidental, and beyond legal remedy, many of them more theoretical than practical, and in the future more than in the present.

The legislature of Michigan in 1883–84 gave much consideration to measures for the regulation of the railroads of that state. The legislature, like the Governor and state officials, had been elected on an anti-railroad platform. The railroad commissioner at that time, after a thorough investigation, not presumably friendly to the railroads, made a report strongly favoring conservative action, declaring that state legislation in railroad matters frequently aimed at impossible results; that the provision for the regulation of rates, and interference with railroad business generally, was of very questionable value or expediency. The conditions were such that it was, in his opinion, not at all certain that the interests of the public and the corporations would not be best promoted by leaving the great principle of supply and demand to regulate the price of railroad transportation, the same as it does the commodities carried. If left to regulate itself, as does the question of rates on the high seas, only restricted to such reasonable limitations as the legislature had obvious authority to impose, and could safely provide, he had no doubt that the railroad tariffs would soon become as nearly uniform, and rates as low throughout the country, as the cost of bridging and building, coupled with the amount of tonnage to be carried, would justify, commensurate with a fair return upon the capital invested in the roads. Under the comparatively unrestricted system existing in that state, he had found little or no dissatisfaction with the situation, not a single complaint of discrimination having reached his office. The Michigan commissioner has accomplished more than the commissions of many other states in securing improvements in the physical condition of the railroads, advising and virtually compelling the improvement of road-bed and mechanical appliances in the interest of safety and the comfort of passengers.

A report upon the operations of the Kansas law says that an act for the regulation of railroads in that state, providing that the maximum rate for the transportation of passengers should be three cents per mile, and for the regulation of freight charges, has led to experiments which have done much to show how closely allied are the interests of the state with the interests of her railroads, and how greatly it is to the interest of the state that her railroads should have freedom in their commercial operations.

Illinois, after many experiments, finally attained more than the average degree of success with a commission to which considerable powers are intrusted. Many alleged abuses have been corrected, and, after a series of contests, the recent reports of the commission declare that little difficulty is now encountered, and that the decisions are quite generally and readily accepted.

Before the Senate investigating committee on interstate commerce in 1885, Henry V. Poor said that in the matter of acquiring and distributing information concerning the operations of railroads, state boards of railroad commissioners were doing a great deal of excellent work, but their powers are to a great extent, or should be, advisory. They are not, nor should they be, legal tribunals. Nearly all the states have or are instituting commissions. All the states should have such boards working harmoniously and prudently to the same end. Rapid progress in prosperity and judicious railroad regulation would be the result, and one state would benefit by the experience of another, and all communities and all interests would learn that what was best for one would be best for all.

Of late the belief that state commissions are of real value and importance appears to have become more general.

The Massachusetts commissioners, in response to a call of the New York Chamber of Commerce, in or about 1881, vigorously defended the usefulness and importance of state commissions, the principles underlying them, and the work which they could accomplish. The commission maintained that there was no doubt that railroads should be compelled to treat all shippers with equality under like circumstances; that local and personal discriminations should be prevented by state laws under heavy penalties, and that such laws were best enforced when a railroad commission existed in each state to investigate charges of discrimination, bring public opinion to bear upon offending corporations and institute prosecutions in the courts. It was not consistent with the public welfare or rights of citizens to allow railroad managers to decide what persons should be favored and what places developed by discriminating rates. Legislatures never intended to place such enormous power in the hands of corporations. It might bo doubted whether legislatures had constitutional authority to delegate such power.

The commission did not believe that a fixed limit could be placed in advance in the charges of railroads, the rule which would be right in one case doing injustice in another.

A review of all state legislation growing out of the granger movement shows that in every instance the efforts to regulate railroad business were overdone, that the legislatures were incompetent for the work attempted, and that entire communities suffered for the evil inflicted upon the railroads. Throughout the west and north-west it may be said that more evil than good has been done by the reckless and injudicious attempts at railroad regulation by law, and in almost every state this has been so fully acknowledged that the early experiments have been abandoned and more conservative principles adopted in their place. Wherever, as in California, the authority conferred upon the commissioners has been in response to an extravagant anti-railroad sentiment, and has gone to unreasonable length, it has been nullified either by shrewd evasion or bold defiance on the part of the railroads, or by popular consent. Throughout, the plaintive cry has gone up that the tendency of much of the railroad legislation was to restrict and discourage where encouragement was needed, and that a vast proportion of what was attempted with the avowed purpose of protecting the rights of shippers against railroads was in fact injurious to the interests of shippers and the communities in which they lived.

Some idea of the uncertain conditions which railroads have been obliged to accept may be obtained from a review of the enactments in various states during any month or week of recent years when a considerable number of state legislatures were in session. It has not been unusual that during a single week a dozen or a score of states adopted some new law, or some important modification of existing laws affecting railroad matters.

In 1885, at Springfield, Illinois, an important step was taken in the history of state railroad commissions in the first efforts to organize a national convention of railroad state commissioners. Prompted by a provision of the Alabama statute directing the commission of that state to consult with other states, efforts were made through this means to harmonize state legislation, and to secure a mutual interchange of views at annual conventions. It cannot be said that very much was accomplished by these national conferences, as issues of state rights and wide differences of opinion on almost all subjects interfered with harmonious action. It was, however, demonstrated in several instances that the opinion of a majority of the delegates was that stringent, arbitrary, and specific provisions of law governing rates and railroad management were inexpedient and inefficient. This national organization made considerable effort to harmonize the methods of railroad regulation in the various states, but conceded that such efforts as were being made often led to confusion, and were not infrequently accompanied by injurious effects. During 1887 the objects aimed at by this national organization of state commissions have been to some extent attained by the organization of the interstate-commerce commission, authorized by an act of Congress, which represents the first important effort to regulate all railway operations that extend from one state into another state by the Federal or National government.

NEW METHOD OF ORGANIZING RAILWAY COMMISSIONS.

A proposed new method of organizing railway commissions is represented by a bill introduced in the British Parliament in 1887, which contemplates an alliance with the judicial authorities in such a manner that the commission proper can practically do nothing of importance without the approval of a judge of high standing. On the other hand, all the judges of the country can occasionally be pressed into temporary service as adjuncts of the commission, when questions arise in their respective districts.

The permanent commission is to consist of two appointed commissioners, one of whom is to be experienced in railway business, and a third *ex officio* judicial commissioner, who is to be, in England, the Lord Chancellor, in Scotland, the Lord President of the Court of Sessions, and in Ireland, the Lord Chancellor of Ireland. Neither of these *ex officio* commissioners is to be required to attend proceedings in any part of the United Kingdom except that for which he is nominated, as stated above. They are also empowered to transact the duties that will devolve upon them, either by personal attendance or through such judges as they may deputize, and the latter course will presumably be frequently pursued if the bill becomes a law.

The clause relating to this subject says: "For the purpose of the attendance of the *ex officio* commissioners, regulations shall be made from time to time by the Lord Chancellor, the Lord President of the Court of Sessions, and the Lord Chancellor of Ireland, respectively, in communication with the *ex officio* commissioners for England, Scotland, or Ireland, as the case may be, as to the arrangements for securing their attendance, as to the times and place of sitting in each case, and otherwise for the convenient and speedy hearing thereof. Such regulations may provide *for the attendance at any case of any other judge*, either at the assizes or otherwise, where it may be convenient to the parties that the case should be so heard, or where the *ex officio* judge is unable to sit and hear the same, or there is no *ex officio* judge for the time being assigned, and such judge shall for the purpose of such case be an *ex officio* commissioner."

In regard to the relative position of the appointed commissioners and their judicial coadjutors the bill says "not less than three commissioners shall attend at the hearing of any case, and the *ex officio* commissioner shall preside, and his opinion upon any question of law shall prevail."

This form of organization apparently places the commission entirely under the control of the existing judges in matters relating to interpretations of the law or the bearing of enactments upon such cases as are presented.

In view of the frequency with which legal questions of great importance arise in connection with the controversies in which railways are involved, and the probability of appeals from a commission to the courts when commissioners make rulings which are considered illegal, the plan posseses advantages that are worthy of consideration in connection with any attempt that may be made to reorganize any of the numerous railway commissions of the United States.

FALSE PRINCIPLES OF RAILWAY LEGISLATION.

A NUMBER of the failures of legislative efforts to regulate railway operations are due to the fact that they were based on false principles. One of the most mischievous is the assumption that all charges for transportation are in the nature of a tax, which it is the duty of legislators or railway commissioners to reduce to the lowest attainable limit, for the purpose of promoting the prosperity of all classes not closely identified with railway companies as employés or as investors in their securities. This theory practically places transportation agencies in an attitude of actual or relative antagonism to the main body of the people. One of the clearest statements of it ever made is embraced in the following extract from the second annual report (1871) of the board of railway commissioners of Massachusetts: "The commissioners base their investigations and all their economical conclusions on this principle: All sums exacted from the community for transportation, whether of persons or of property, *constitute an exaction in the nature of a tax,* just as much a tax as water rates, or the assessments on property, or the tariff duties on imports. That it is wholly, or in fact, a necessary tax, one which can at most only be reduced to a certain point, but never abolished, this, in no degree, affects the principle. It is still a tax, adding in itself nothing to the intrinsic character of property, nor affecting the condition of persons, but simply moving the one or the other from point to point. *The reduction of this tax* to the lowest possible amount paid for the greatest possible service rendered, always observing, of course, the precepts of good faith and the conditions of a sound railroad system, this *must be the great object the commissioners always retain in view.*"

This frank and forcible avowal of one of the most intelligent of the state commissions, after the commencement of their labors, presumably explains the leading motive or principle of action which animated sundry other railway commissioners or legislative bodies in their attempts to discharge duties analogous to those assumed by the Massachusetts commission. The real nature of transportation labors, therefore, appears to possess sufficient importance, in connection with the controversies that have arisen, to justify a brief reference to this subject. No fact in modern industrial history is more evident or better established than that American railways have effected enormous reductions in freight charges since 1871, and most of these reductions have arisen from other causes than legislative regulations, but if it is true that such charges are of the nature of a tax, there would be reasons for governmental efforts to enforce restrictions, which do not exist if the views stated below are correct.

RAILWAYS NOT TAX GATHERERS.

It is a common thing for advocates of repressive laws to denounce railways as tax gatherers, and to speak of all charges for transportation as taxes. It is generally popular and often just and wise to reduce taxation. Governments tax but they do not produce. The working forces of a country produce but they do not tax. A confusion of ideas and expressions has sprung up in regard to the proper classification of transportation charges, which has partly arisen from the fact that under old systems a considerable portion of the cost of freight movements was defrayed by taxation, and might, therefore, with propriety be termed a tax. When township, county, or state authorities open a road, and provide the cost of construction and maintenance by levying a tax upon the inhabitants of the district benefited, the part of the transportation charges over such a road which is represented by the benefits derived from its use, may be considered a tax. The part of the actual cost of transportation over the New York canals, which is represented by the interest on the sum required to construct them and the charges for keeping them in repair, being defrayed by the main body of the people of that state, may be considered taxation. But it is scarcely correct to say that the sum charged by boatmen for their services and the use of their boats, in conveying grain from Buffalo to New York is a tax, and it is scarcely to be expected that any national or state legislators would base interference with, or regulation of, the charges made by farmers for hauling freight over common roads from one point to another, on the ground that their bills for such labors were substantially taxation. In brief, some portions or items of some transportation charges may, with a certain degree of propriety, be called taxes, but such a phrase is not justly applicable to any of the railway movements, except, in a small degree, to those made upon the comparatively few existing lines that have been materially aided, financially, by state appropriations or by Federal land grants and money subsidies. In a broad sense, and speaking of the principal portions of the railway system now existing, it differs radically from preceding methods of transportation in the fact that no important part of the charges imposed by it partake of the nature of taxation. It is an essential element of a tax that it should be a rate or sum of money assessed on the person or property of the citizen by a government for public use. If the word is used in any other sense it can be applied to any expenditure with quite as much propriety as to freight charges, and when such a latitudinarian meaning is adopted the phrase ceases to have an offensive application, or to possess any special pertinency whatever in connection with the discussion of railroad questions.

RAILWAYS AS PRODUCERS.

In view of some of the theories advocated, and the attempts made from time to time to produce the impression that railways necessarily occupy a position antagonistic, in its inherent characteristics, to that of the general public, it is desirable that their position as producers should be fully understood. Little or none of the debateable legislation proposed or perfected aimed at affecting them simply in their position as owners of lines over which freight is forwarded. The objective point was usually railways in their joint or double function, as the owners or controllers of such lines, who were engaged in the business of common carriers. To prove that the standard railway labors are essentially productive, and not mere tax-gathering, it is only necessary to present the views of some of the leading authors on political economy on that subject:—

John Stuart Mill, the greatest of modern English political economists, in defining production, states that its requisites are "labor and appropriate natural objects;" that labor in the physical world "is always and solely employed in putting objects in motion; the properties of matter, the laws of nature do the rest. . . . This one operation of putting things into fit places, and being acted upon by their own internal forces and by those residing in other natural objects is all that man can do with matter. He only moves one thing to or from another. He moves a seed into the ground and the natural forces of vegetation produce in succession a root, a stem, leaves, flowers, and fruit." Mr. Mill shows, by a number of illustrations, that *transportation, of one kind or another, lies at the root of all production;* and if you take away from men's labors that portion which consists in the movement of various inanimate objects from one point to another, *there would be absolutely nothing productive left.*

In a specific enumeration of the various classes of agents engaged in production, Mr. Mill distinctly enumerates transporters in the following extract:—

"There is a very great amount of labor employed, not in bringing the product into existence, but in rendering it, when in existence, accessible to those for whose use it is intended. Many important classes of laborers find their sole employment in some function of this kind. There is, first, the whole class of carriers, by land or water, muleteers, wagoners, bargemen, sailors, wharfmen, coal heavers, porters, railway establishments, and the like. Next, there are the constructors of all the implements of transport, ships, barges, carts, locomotives, &c., to which must be added roads, canals, and railways."

American authors on political economy, although differing widely on many topics from the English writers, substantially agree with Mr. Mill in reference to the point under discussion.

Dr. William Elder, in Questions of the Day, Economic and Social, published in 1871, says: "Change of form, including a change of properties and change of place, are both included in the word production. Ore or coal or lime delivered at the pit's mouth are produced. The ore and coal and lime being put through the furnace, iron, by change of form, is produced. The iron transported to a distant market is there, by change of place, produced. By the change of form utility is subserved. By the change of place use is effected."

Henry C. Carey, in his work on the principles of political economy, published in 1837, also enunciates doctrines which distinctly rank transporters as producers. After saying that "to produce may, therefore, be defined to be to occasion an alteration in the condition of existing particles of matter, by which that matter may be rendered more useful or agreeable than in its present state," he proceeds to illustrate this doctrine by showing who can be classed as producers of tea grown in the interior of China, and subsequently consumed in New York or Liverpool, and he classes among these producers "the persons employed in its transportation," and "the master and sailors of the vessel by which it is transported" from the place where it is grown to the place where it is consumed.

The direct influence exercised by railways in stimulating production, and in rendering available natural resources of immense magnitude, is particularly noticeable in the United States. A large proportion of the agricultural and mining districts of this country owe their existence as important centres of production to the extension of railways. The land-grant railways have hastened the occupation and cultivation of new lands, and there are to day millions of citizens living on homesteads in young territories and states who would never have sought their present locations, and never developed the latent resources of the soil they are now tilling, if railways had not established the convenient existing systems of transportation. This process is continually progressing in conjunction with the analogous movement of steadily reducing the average rates for moving freight per ton per mile, as traffic accumulates and terminal facitities are improved, and each of these advancing strides has an immense influence in enlarging the effectiveness of the railways as one of the greatest of the co-workers in production.

The vast movement of agricultural produce from interior portions of this country to the seaboard, and thence to foreign countries, could never have assumed its present proportions without railway assistance, and in the absence of the opportunities for obtaining foreign markets which railway extensions have furnished, the most powerful of the incentives to a large proportion of the productive agricultural energy of the United States would not now exist.

In connection with the bulky metals and minerals, transportation forms as indispensable an agent of production as in the movement of agricultural staples over the long distances which usually intervene between the point of growth and the point of consumption.

Throughout the whole range of its labors as a freight carrier the true position of the railway is that *of a prominent factor in the great work of production.* Whatever theories may prevail on the subject, this fact is always recognized when a railway is projected, and it is only forgotten or ignored when disputes spring up between various classes of producers relating to their respective shares of the sum derived from the consumer.

Some acrimonious controversies would be wholly avoided if the fundamental truth was recognized that all producers are transporters and all transporters are producers. There is no act or form of production effected or superintended by human agencies which does not consist in placing elementary bodies in new relations by moving them from one point to another, and subjecting them to diverse manipulations; and after the preliminary movements in the mine, field, or factory are completed, it is just as much a part of the process of production to convey the finished fabric to the point of consumption as it was to move ore to the furnace, or pig iron to the mill, or grain from the harvest field to the barn. Few or none will deny that all the freight movements which precede the completion of a finished article are part of the cost of its production, but it is not so generally understood that the cost of conveyance to the point of consumption is also part of the cost of production, so far as the trade at that particular point is concerned.

The manufacturer of New England who wishes to compete with a rival establishment located at Chicago or St. Louis must see that his western customer does not suffer by a continuance of his old trade connections. The farmer living west of the Mississippi who wishes to sell his corn, wheat, pork, or live stock in England must make it the interest of the English consumer to buy his products. If his business consists mainly in raising produce for a foreign market, and one of the greatest obstacles to be surmounted is the transportation overland for a distance of a thousand miles, the railway lines that perform this portion of the requisite labor, are practically and theoretically fellow-producers. The idea is fallacious that the farmer and the railway company stand on a radically different footing in reference to the nature of their avocations, and that this difference is so vital that governments should arbitrarily prescribe the share of compensation which each of the parties concerned in the enterprise of raising and delivering produce in a distant market should receive. The laws of trade are better regulators of such affairs than legislative bodies or government officials. Railway companies are not only manufacturers of transportation who are compelled to employ very expensive and complicated aids and agencies, but they are also joint producers with all the farmers, planters, miners, lumbermen, and manufacturers who need their services in reaching distant markets.

FREEDOM OF CONTRACT AND LAWS OF TRADE.

Other principles sometimes violated in attempts at railway regulation, to an extent scarcely warranted, relate to the range which should be left for all citizens who risk their money in useful but perilous enterprises for the freedom to make such business arrangements as may from time to time be found advantageous or absolutely necessary for the successful management of their affairs. The restrictions placed upon all common carriers by common-law requirements constantly exercise a restraining power of varying significance. The pivotal points of many disputes hinge on the extent to which the efficiency of the common-law requirements shall be increased by new enactments, and sometimes measures are proposed which would abolish all remaining vestiges of freedom of contract, and doom companies to hopeless bankruptcy, in view of the exigencies to which they are subjected by inexorable laws of trade. A considerable degree of freedom is necessary to secure the best results. If the national and local statesmen of this country had undertaken, at all stages of transportation development, to apply such rigid regulations as are frequently proposed, to the schemes that have materialized, or if they had used the powers of the nation and the respective states to create all the extensive systems that were to be tolerated, it can scarcely be contended that the net results would have been as satisfactory as those which were actually attained. The probabilities point strongly in the opposite direction, and if the outcome of governmental efforts to plan and execute afford a fair indication of what would have occurred if they had monopolized all such undertakings, the existing state of things would be deplorable. The manacled man may not become a thief or a murderer, but it will be impossible for him to attain the highest possible degree of usefulness as a citizen. The plea for a reasonable degree of freedom was forcibly expressed in the following extract from views announced by Judge Cooley, head of interstate-commerce commission in 1887, a few years before he received that appointment:—

"The railroad ought to be considered, and ought to be made, the convenient and accommodating servant of the public, existing to do its will; but the public will that is to be served ought to be a just and reasonable will, and *should demand nothing which the owners of railroad lines had no reason to anticipate when they invested their money in this species of property, and which they cannot, therefore, be said to have bargained for.* To deny the railroads reasonable compensation, *to cripple and hamper them by needless and vexatious legislation, to load them down with unreasonable burdens,* will appear as impolitic from the standpoint of public interest as it would be *for an employer to put his servant on short allowance, or to compel him to carry weight at his labor.*"

LOGIC OF TRANSPORTATION DEVELOPMENT.

It is obvious that the extensive experience furnished by the rapid advance of many sections of the country from the lowest to the highest stages of transportation development should have furnished instructive indications of the nature of the legislative methods that have either advanced or retarded the improvements which are indispensable and vital elements of progression. One of the lessons is that the main portion of the country has obtained its principal improvements chiefly through corporate efforts, or in other words, that it is by the labors of turnpike, bridge, canal, railway, and steamboat or steamship companies, rather than by labors of governments or single individuals, that the bulk of the forward movements have been made. At the same time legislation of one kind or another has been a necessary preliminary or adjunct of all corporate movements, and in a number of instances considerable governmental advances have been made for the purpose of either constructing to the point of completion some classes of useful works or of affording useful aid to works undertaken by private companies. Many intricate questions relating to the best methods of attaining desirable results in transportation matters have been practically solved by an approximate degree of uniformity in the outcome of extensive tests in the stern school of experience. Much has been learned of the general drift of affairs when governments undertake to construct canals, or to build and operate railways on their own account, or when the United States, any of the commonwealths, or cities, counties, or towns, became supporters of company projects.

A variety of conflicting policies or systems of regulation have been applied to the operations of transporting companies. Any one who aspires to the honor of becoming a leader in directing legislation on such subjects might presumably learn useful lessons from familiarity with the diverse results hitherto attained; and such information ought to furnish one of the most important general guides to those who are in doubt about the best course to be pursued in such new emergencies or exigencies as may arise. It would certainly be better and more creditable to all concerned if the people could be assured of decisions based on such knowledge, than if the legislative enactments relating to such subjects were the offspring of chance or articles of merchandise.

RAILWAY CONFEDERATIONS OR POOLING ARRANGEMENTS.

IT was obviously impossible for state legislatures to establish regulations of considerable significance applicable to railway movements extending from one commonwealth to another, on account of a lack of legal authority to interfere materially with interstate commerce. Yet it has always been extensive movements, such as those which represent the forwarding of freight from the Mississippi valley to the Atlantic seaboard, which stood in special need of restraints upon reckless competition. As Congress never acted on this subject before it passed the interstate law of 1887, providing for the appointment of a commission, and prescribing sundry rules, some of which are of a kind "more honored in the breach than in the observance," it was formerly impossible to do anything of considerable significance unless it was done by the voluntary action of companies engaged in competitive traffic.

They commenced this gigantic undertaking on a comprehensive scale at an early stage of the eighth decade, and continued their efforts, under numerous disadvantages and discouragements, one of the most serious of which was the lack of legal methods for enforcing agreements made from time to time, to an extent that renders their associated labors one of the most important features of modern American railway history.

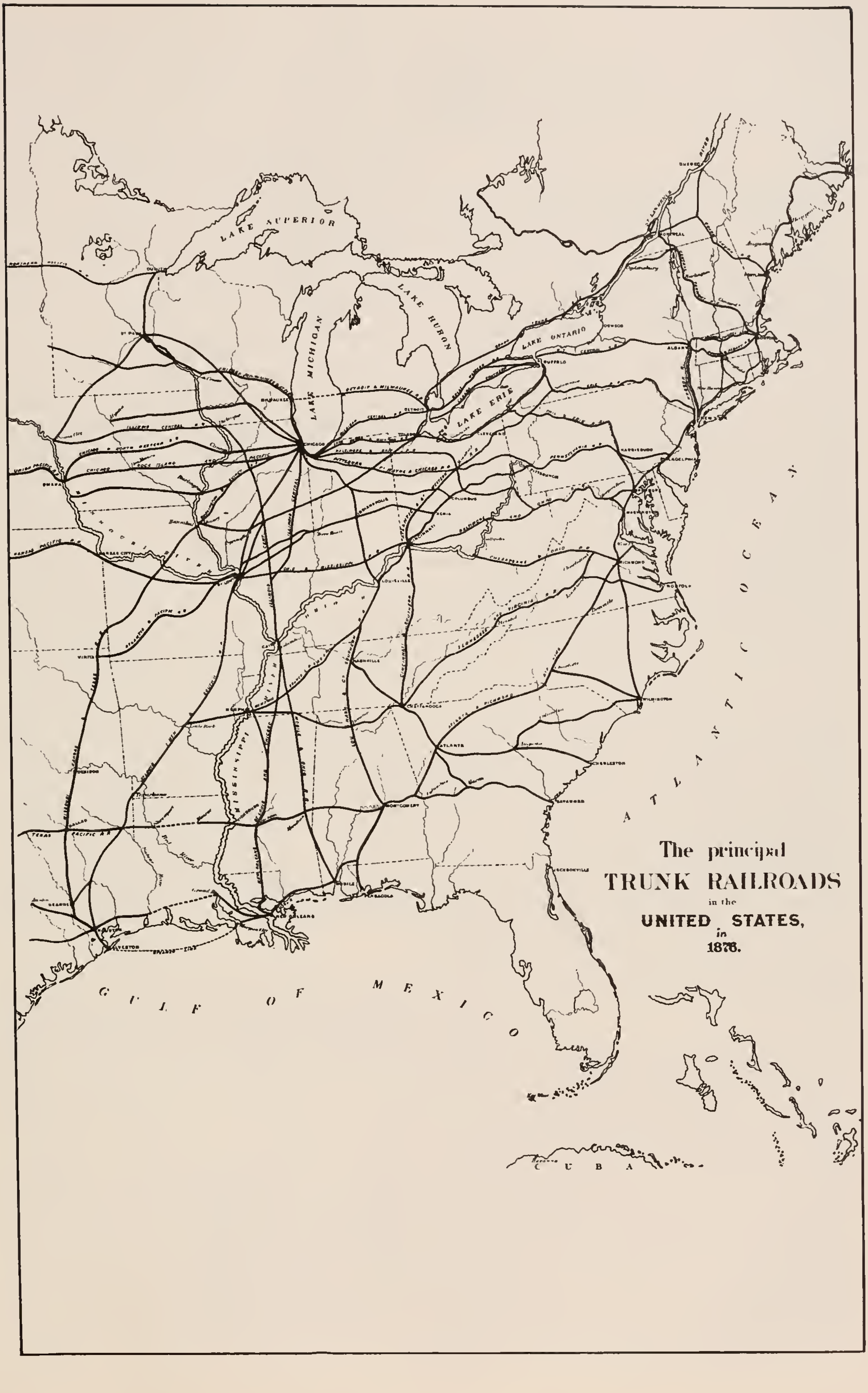
It is universally conceded that something should be done to regulate interstate commerce. The states cannot act effectually. Congress before 1887 did not act at all, and then passed a law which was not entirely satisfactory to advocates of any system or representatives of any interest, and the efforts to do for themselves and the communities they serve what should presumably be done represent a strange intermingling of failures and successes, chiefly because the unanimous and continuous consent of all companies participating in a given class of competitive traffic is necessary to secure the complete efficiency of any confederation that may be formed or any pooling arrangements that may be devised. All voluntary railway associations, which are not legally authorized and sustained by explicit lawful methods for enforcing such agreements as they make from time to time, necessarily labor under disadvantages similar to those which rendered the Polish diet one of the most unfortunate of parliamentary tribunals, inasmuch as the unanimous consent of the members was necessary to secure a binding decision.

In other countries difficulties similar in character, but infinitely less intricate than those prevailing here, have been practically solved by the simple process of making such compacts of competing lines or confederations of rival railway companies as are fully approved by competent authority enforcible in the courts. Corresponding action here would probably furnish a remedy for a large proportion of the troubles developed in the United States, and perhaps for all that are preventible by laws or other means now known. Yet this is precisely the one thing which is never seriously advocated in Congress, and the clause of the interstate-commerce act of 1887 which forbids money pools took strong ground in the opposite direction by materially increasing the obstacles to effective voluntary action on the part of the companies that have endeavored to form confederations.

In general terms it may be said that nearly all classes of traffic for which a considerable number of railway companies have actively competed, have been pooled, and are now (1887) pooled, under various systems, which have been attended with varying degrees of success, and subjected, from time to time, to interruptions or interregnums of short or long duration and to violations of compacts which meant much or little. The only law of American railroading continuously applicable to competitive traffic is

THE LAW OF COMPETITION.

It is always in force, always actively influencing the action of numerous companies, whether pooling arrangements are ostensibly adhered to or openly disregarded. It is a great mistake to suppose that effective pooling destroys or prevents competition. In sundry ways competition may be exceptionally active during periods when compacts are apparently adhered to with an unusual degree of fidelity. No company knows how long an agreement may be effective, and all rival lines endeavor to establish the best practical safeguards against a renewal of energetic strifes, and to create a favorable record in the matter of amount of business transacted, which can be advantageously used in controversies relating to the apportion-


LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
ATLANTIC OCEAN
GULF OF MEXICO
CUBA
The principal
TRUNK RAILROADS
in the
UNITED STATES,
in
1876.

ment of traffic which are of comparatively frequent occurrence. It may be considered a demonstrated fact that confederations cannot prevent or destroy competition, and that their principal effect is to subject it to some sort of restraint or regulation.

This will be apparent to all who give due heed to the principle or theory on which all important pooling arrangements relating to the division of traffic have been based. A number of lines use every possible effort to secure the largest attainable share of the competitive traffic originating at or between given points. After a succession of struggles, extending over a series of years, the percentage obtainable by each line is approximately ascertained. The most vital feature of the pool is an agreement that prescribed rates shall be maintained by all the companies, that each shall be allowed to obtain or transact an amount of business corresponding as closely as possible with the allotted percentage, and that if any company obtains more than its allotted percentage the profits derived from such excess shall be paid over to the company or companies that have failed to obtain an amount of business corresponding with their allotment. The end constantly kept in view was to take from all the companies concerned, as far as possible, all incentives to rate cutting, by putting in force a system under which no company could increase its profits during a given period by increasing, beyond its allotment, the amount of its competitive business originating at the point or points to which the pool related, and no company could lose net revenue by failure to obtain a percentage of the total business equivalent to its allotment.

The pivotal point of such arrangements necessarily was the allotment of percentages, and as they were avowedly subject to change from time to time, whenever any company could furnish satisfactory evidence of its ability to obtain, in a desperate and mutually injurious conflict, a larger amount of business than had been awarded to it, an incentive to active competitive exertions was always furnished by this fact, even during eras of the closest adherence to the letter and spirit of pooling arrangements. When there was nothing to compete for, rank in the matter of claim to a share of business awarded at the next allotment invariably supplied an incentive to earnest struggles. The idea has been widely disseminated that pooling necessarily annihilated competition, but it is too deeply interwoven with the entire framework of the American railroad system to be extinguished either by confederations or anything short of such absolute identity of interests as is produced by permanent or protracted consolidations.

Various methods have been tried for the purpose of accomplishing the leading object of pools, which are to enable the companies transacting the business leading to or from given points under conditions that will enable them to extract a profit from such business, instead of continuing to conduct it at rates which entail a loss.

THE ANTHRACITE COAL COMBINATION.

The first important combination was formed by the lines engaged in the transportation of anthracite coal. It differed materially from all others in the fact that a leading object in view was to maintain a remunerative price for that important product, mainly by an agreement intended to restrict the output, and to divide between the carriers, which were at the same time deeply interested in mining operations, the total amount of competitive traffic in accordance with agreed percentages.

The first compact was formed as a protection against ruinous competition. It continued in force from December 1st, 1872, to August, 1876. During its continuance the prices of coal were not excessive, but after its disruption the rates of transportation from the mines, as well as the price of coal, again fell to a ruinously low standard. Several of the companies were unable to declare dividends, one went into the hands of a receiver, and another was obliged to obtain from its creditors an extension of time for the payment of debts. On January 1st, 1878, a second combination went into effect, and continued until the close of that year. The allotment of percentages was as follows:—

	Per cent
Philadelphia and Reading	28.625
Lehigh Valley	19.750
Central of New Jersey	12.905
Delaware, Lackawanna and Western	12.750
Delaware and Hudson	12.480
Pennsylvania	7.625
Pennsylvania Coal Company	5.865
	100.000

This arrangement continued in force until December 31st, 1878, when a disruption occurred, mainly in consequence of a refusal of one of the companies to accept terms agreed upon by the other companies.

During most of the years from 1878 to 1887 similar compacts were in force, to a certain extent, but they were scarcely ever fully effective, although they did much to check excessive production, partly on account of a refusal of one of the companies concerned, the Pennsylvania Railroad Company, to enter into a combination which had for its object the restriction of the production of coal, and partly on account of various dissensions and legal hostilities.

THE EVENER SYSTEM, APPLIED TO LIVE STOCK AND PETROLEUM.

As was to be expected, one of the first experiments made in connection with the pooling of freight which railway companies did not produce, was decidedly unsatisfactory in some of its workings to sundry interests, encountered severe criticisms, and perhaps elicited the bitterest attacks that have ever been made upon American railways. This method was popularly known as the evener system, and it was applied principally to live stock and petroleum traffic. The "cattle eveners pool" was organized in 1875, for the purpose of terminating a protracted contest between trunk lines and connections extending from Chicago to Boston, New York, Philadelphia, and Baltimore, which had frequently led to the transportation of live stock at rates far below the actual cost of such movements. The plan adopted consisted first, in an agreement between the rival companies in regard to a division of the traffic, or the percentage of the total amount of business which each company should transact. The next step, according to one account, was entering into "an arrangement with an association of certain of the principal shippers, who agreed to direct their shipments in such manner as to insure to each company its allotted share of the traffic, or, in other words, to keep the number of cattle shipped over each particular road embraced in the pool even with, or equal to, the percentage agreed upon as the share of that road. These shippers were, therefore, known as 'eveners.' In consideration of the services performed by the eveners, they were allowed a rebate not only upon shipments made by themselves, but also upon all cattle shipped by other parties to other places east of Chicago. This arrangement gave them a great advantage over all other shippers, and thus tended to create a monopoly of the business. The scheme met with strenuous and determined opposition, and it was abandoned by the railroad companies in the spring of 1879," since which period live stock has been transported under regulations similar to those pertaining to other classes of traffic.

The evener system was also adopted in connection with the transportation of petroleum from the producing regions in Pennsylvania to seaboard and other points at which considerable quantities of petroleum were refined, for several years before the extensive pipe lines were constructed through which the bulk of the crude petroleum is now forwarded to distant refining points. The Standard Oil Company acted as evener under conditions similar to those already described relating to live-stock traffic, and it received as a compensation for its division of business between the competing lines, in accordance with agreed percentages, special advantages, in the matter of rates, corresponding to those granted to the cattle eveners.

It is scarcely necessary to add that the method thus briefly described forms no part whatever of the main portion of the railway pooling systems of the country. It is only applicable to special descriptions of products of which large quantities are moved, and has been practically and, probably, permanently abandoned even in relation to them. It represents a device of a transition period, when desperate remedies were applied to desperate diseases. Some of the antagonisms it provoked were peculiarly virulent, protracted, and influential. The initiatory steps, which finally resulted in the passage of the interstate-commerce law of 1887, or more particularly those features of it which originated in the House of Representatives at Washington, were based on efforts to prevent by law the application of the evener system to the transportation of petroleum.

The first vigorous effort to establish a confederation or pooling combination, applicable to all classes of business, and requiring for its successful operation the support of a considerable number of lines, was commenced in December, 1873, by four roads connecting Atlanta, Georgia, with the seaboard, which soon secured the co-operation of numerous lines subsequently combined under the title of

THE SOUTHERN RAILWAY AND STEAMSHIP ASSOCIATION.

In the fall of 1875 a definite revised agreement was signed by representatives of the following railroad lines, viz.: Western and Atlantic; Central of Georgia; South-western; Savannah, Griffin and North Alabama; Mobile and Girard; Augusta and Savannah; Eatonton branch, Georgia; South Carolina, Richmond and Danville; Piedmont; North Carolina; Atlanta and Richmond Air Line; Memphis and Charleston; East Tennessee, Virginia and Georgia; Western, of Alabama; Montgomery and Eufaula; Wilmington, Columbia and Augusta; Charlotte, Columbia and Augusta; Wilmington and Weldon; South and North Alabama; Nashville, Chattanooga and St. Louis; and the following steamship companies, viz.: Ocean Steamship Company, of Savannah; Philadelphia and Southern Mail Steamship Company; New York and Charleston steamship lines. In 1879 it was reported that this organization had been joined by forty railroad companies and a number of coastwise steamer lines. In the early portion of 1887 the companies participating and officers were reported as follows: Virgil Powers, general commissioner, Atlanta, Georgia; Charles A. Sindall, secretary, Atlanta, Georgia; Milo S. Freeman, auditor, Atlanta, Georgia; E. T. Hughes, general agent, 291 Broadway, New York; arbitrators, John Screven, of Georgia; Theo. H. Carter, of Virginia; E. B. Sibley, of Missouri; Atlanta and West Point; Baltimore and Richmond Steamship Company; Boston and Savannah Steamship Company; Central Railroad and Banking Comrany, of Georgia; Charleston and Savannah; Charlotte, Columbia and Augusta; Cincinnati, New Orleans and Texas Pacific; Columbia and Greenville; Clyde New York steamship lines; East Tennessee, Virginia and Georgia; Georgia Railroad and Banking Company; Louisville and Nashville; Memphis and Charleston; Merchants' and Miners' Transportation Company; Mobile and Girard; Mobile and Montgomery; Montgomery and Eufaula; Nashville, Chattanooga and St. Louis; New York and Charleston Steamship Company; Norfolk and Western; Ocean Steamship Company; Old Dominion Steamship Company; Port Royal and Augusta; Richmond and Danville; Rome; Savannah, Florida and Western; Savannah, Griffin and North Alabama; Seaboard and Roanoke; South Carolina; South and North Alabama; Vicksburg and Meridian; Western and Atlantic; Western, of Alabama; Wilmington and Weldon; Wilmington, Columbia and Augusta.

In a comparatively short time after the Southern Railway and Steamship Association was in successful operation, several other organizations of a similar character were formed for the purpose of attempting to regulate the competitive transportation movements of other sections, until finally they practically embraced within their membership all the important competitive roads of the country.

TRUNK-LINE COMMISSION AND CENTRAL TRAFFIC ASSOCIATION.

An arrangement was perfected in July, 1877, under the guidance of Albert Fink, by which a damaging contest between the east and west trunk lines was terminated, and the initial steps taken for the establishment of the association controlling competitive traffic between western and north-western states and the Atlantic seaboard. In the amount of business subject to supervision and magnitude of the railway interests involved this was the most important association formed in the United States. It was subjected to numerous vicissitudes and periods of extensive rate-cutting, one of the most important of which was terminated by an important new contract of the trunk lines, made in November, 1885. Despite many difficulties, its operations gradually expanded, until, at the time of the passage of the interstate-commerce act, in 1887, its officers, actively participating lines, and sub-divisions had attained the magnitude indicated by the following official list:—

Trunk-Line Commission.

Albert Fink, commissioner, 346 Broadway, New York; N Guilford, commissioner (freight department), 346 Broadway, New York; S. F. Pierson, commissioner (passenger department), 346 Broadway, New York; C. W. Bullen, secretary (freight department), 346 Broadway, New York; William Fleming, secretary (passenger department), 346 Broadway, New York; H. C. Blye, general agent, 346 Broadway, New York.

Joint Executive Committee.

Albert Fink, chairman; S. F. Pierson, vice-chairman (passenger department); C. W. Bullen, secretary (freight department); H. C. Blye, general agent, 346 Broadway, New York; Allegheny Valley; Baltimore and Ohio; Boston and Albany; Boston, Hoosac Tunnel and Western; Buffalo, New York and Philadelphia; Chicago and Alton; Chicago and Atlantic; Chicago and Grand Trunk; Chicago, St. Louis and Pittsburgh; Cincinnati, Hamilton and Dayton; Cincinnati, Indianapolis, St. Louis and Chicago; Cincinnati, Washington and Baltimore; Cleveland, Columbus, Cincinnati and Indianapolis; Detroit, Grand Haven and Milwaukee; Detroit, Lansing and Northern; Evansville and Terre Haute; Fitchburg; Grand Rapids and Indiana; Grand Trunk; Indianapolis and St. Louis; Indiana, Bloomington and Western; Lake Erie and Western; Lake Shore and Michigan Southern; Louisville, New Albany and Chicago; Michigan Central; New York and New England; New York Central and Hudson River; New York, Chicago and St. Louis; New York, Lake Erie and Western; New York, New Haven and Hartford; New York, Pennsylvania and Ohio; Ohio and Mississippi; Pennsylvania Company; Pennsylvania; Peoria, Decatur and Evansville; Philadelphia, Wilmington and Baltimore; Pittsburgh, Cincinnati and St. Louis; Vandalia Line; Wabash, St. Louis and Pacific.

East-Bound Classification Committee.

R. M. Frazer, chairman, Cincinnati, Ohio; William Orr, secretary, Toledo, Ohio; G. G. Cochran, C. L. Cole, R. M. Fraser, R. W. Geiger, C. E. Gill, H. W. Hibbard, Edgar Hill, M. Knight, A. Mackay, D. T. McCabe, J. T. R. McKay, John Porteous, G. B. Spriggs, W. S. Ward. List of the parties to the various divisions of traffic from the respective points named: West bound —From New York—Baltimore and Ohio; Delaware, Lackawanna and Western; New York Central and Hudson River; New York, Lake Erie and Western; Pennsylvania; West Shore. From Philadelphia—Baltimore and Ohio; New York Central and Hudson River; New York, Lake Erie and Western; Pennsylvania. From Boston—Boston and Albany; Central Vermont; Fitchburg; New York and New England. From Baltimore—Baltimore and Ohio; Pennsylvania. East bound—From trunk line western termini—Baltimore and Ohio; Delaware, Lackawanna and Western (live stock only); Grand Trunk; New York Central and Hudson River; New York, Lake Erie and Western; Pennsylvania.

Central Traffic Association.—Passenger Department.

George H. Daniels, Assistant Commissioner, Chicago, Ill.

Baltimore and Ohio—Lines west of Wheeling and Parkersburg; Chicago and Atlantic; Chicago and Grand Trunk; Chicago, St. Louis and Pittsburgh; Chicago and West Michigan; Cincinnati, Indianapolis, St. Louis and Chicago; Cincinnati, Washington and Baltimore; Cleveland, Columbus, Cincinnati and Indianapolis; Cleveland, Akron and Columbus; Detroit, Grand Haven and Milwaukee; Detroit, Lansing and Northern; Grand Rapids and Indiana; Grand Trunk—Lines west of Suspension Bridge and Toronto; Indianapolis and St. Louis; Indiana, Bloomington and Western; Jeffersonville, Madison and Indianapolis; Lake Erie and Western; Lake Shore and Michigan Southern; Louisville and Nashville; Michigan Central; New York, Chicago and St. Louis; New York, Pennsylvania and Ohio; Ohio and Mississippi; Pennsylvania Company; Pittsburgh and Lake Erie; Pittsburgh, Cincinnati and St. Louis; Saginaw

Valley and St. Louis; Vandalia Line; Valley; Wabash, St. Louis and Pacific—Lines east of St. Louis and Springfield.

Chicago East-Bound Passenger Committee.

George H. Daniels, Chairman, 205 La Salle Street, Chicago, Ill.

Companies.—Baltimore and Ohio; Chicago and Atlantic; Chicago and Grand Trunk; Chicago, St. Louis and Pittsburgh; Lake Shore and Michigan Southern; Michigau Central; Pittsburgh, Fort Wayne and Chicago.

CENTRAL TRAFFIC ASSOCIATION.

205 La Salle Street, Chicago, Illinois.

G. R. Blanchard, commissioner; G. H. Daniels, assistant commissioner, passenger department; C. H. McKnight, secretary.

Chicago Committee.—Charles L. Shaw, Secretary.

Baltimore and Ohio; Chicago and Grand Trunk; Chicago, St. Louis and Pittsburgh; Lake Shore and Michigan Southern; Michigan Central; New York, Chicago and St. Louis; Pittsburgh, Fort Wayne and Chicago.

St. Louis Committee.—H. S. DePew, Joint Agent.

Chicago and Alton; Indianapolis and St. Louis; Ohio and Mississippi; Vandalia Line; Wabash, St. Louis and Pacific.

Peoria Committee—W. A. Brubaker, Joint Agent.

Chicago, Rock Island and Pacific; Indiana, Bloomington and Western; Peoria, Decatur and Evansville; Wabash, St. Louis and Pacific.

Indianapolis Committee.—J. M. Bowles, Joint Agent.

Chicago, St. Louis and Pittsburgh; Cincinnati, Hamilton and Dayton; Cincinnati, Indianapolis, St. Louis and Chicago; Cleveland, Columbus, Cincinnati and Indianapolis; Indiana, Bloomington and Western; Louisville, New Albany and Chicago; Wabash, St. Louis and Pacific.

Cincinnati Committee.—C. W. Temple, Joint Agent.

Cincinnati, Hamilton and Dayton; Cincinnati, Washington and Baltimore; Cleveland, Columbus, Cincinnati and Indianapolis; New York, Pennsylvania and Ohio; Pittsburgh, Cincinnati and St. Louis.

Louisville Committee.—R. H. Campbell, Joint Agent.

Jeffersonville, Madison and Indianapolis; Ohio and Mississippi; Louisville and Nashville.

SOUTH-WESTERN RAILWAY ASSOCIATION.

This organization was formed for the purpose of effecting an agreed division of the receipts from the traffic of the Missouri river points, of Kansas City, Atchison, Leavenworth, and St. Joseph, between the railroads extending from those cities to St. Louis, Chicago, and Toledo, respectively. Shortly after its organization J. W. Midgley, its commissioner, in a communication to the Chief of the Bureau of Statistics, stated that "the general intention of the organization is to maintain such equable rates to and from the Missouri river points as shall admit of lesser or equal rates for shorter distances. To illustrate, the intention is to maintain, say, a 25-cent rate per hundred pounds on wheat from Kansas City to Chicago, which would allow the roads in the association to charge either that rate or a less rate from local points nearer to Chicago." One of the leading objects was to protect local traffic. At the time the interstate-commerce act was passed, in 1887, the leading officers of this association and companies connected with it were as follows:—

J. W. Midgley, Commissioner, Chicago, Ill.
E. D. Moore, General Agent, Kansas City, Mo.

Companies.—Chicago and Alton; Chicago, Burlington and Quincy; Chicago, Rock Island and Pacific; Hannibal and St. Joseph; Kansas City, St. Joseph and Council Bluffs; Missouri Pacific; Wabash, St. Louis and Pacific.

Soon after the passage of that act it became necessary with this, as well as other associations which had features providing for a money distribution between the competing lines, to remodel their arrangements, on account of the prohibition of such distributions in that act, and the course it adopted, which is somewhat more radical than that commonly pursued, is briefly described in the following newspaper statement:—

"At a meeting in Chicago of the general managers of the roads in the South-western Railway Association that organization was reorganized as the South-western Statistical Bureau. Mr. R. B. Cable was elected chairman of the executive committee, and Mr. J. W. Midgley was made chairman of the new organization. The general freight agents were constituted a rate committee, with power to make uniform rates on competitive business. There are no penalties provided, the managers pledging their faith to carry out the agreement. Any line has the privilege of withdrawing on giving ninety days' notice. A separate agreement includes all lumber traffic, but is subject to the same rules and conditions. All of the lines running from Chicago and St. Louis to Kansas City and the Kansas roads are parties to the agreement, with the exception of the St. Louis and San Francisco, and Kansas City, Fort Scott and Gulf."

Other associations, of which Mr. Midgley was commissioner, or which related to south-western traffic, included the following:—

COLORADO-UTAH ASSOCIATION.

J. W. Midgley, Commissioner, Chicago, Ill.

Companies.—Chicago and Alton; Chicago, Burlington and Quincy; Chicago and North-western; Chicago, Rock Island and Pacific; Chicago, St. Paul, Minneapolis and Omaha; Hannibal and St. Joseph; Missouri Pacific; Wabash, St. Louis and Pacific.

PACIFIC COAST ASSOCIATION.

J. W. Midgley, Commissioner, Chicago, Ill.

Chicago and Alton; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago and North-western; Chicago, Rock Island and Pacific; Missouri Pacific; Wabash, St. Louis and Pacific.

A number of associations were formed, at various dates between 1877 and 1887, most of which are included in the following list of those not mentioned above, which were in operation about the time of the passage of the interstate commerce act of 1887:—

NEW ENGLAND STATES.

Railway Clearing House Association.

A. A. Folsom, President, Boston, Mass.
E. B. Hill, Manager, Boston, Mass.

Executive committee.—A. A. Folsom, J. W. Hobart, W. H. Barnes, O. M. Shepard, W. H. Turner.

List of Members.—Boston and Albany; Boston and Maine; Boston and Providence; Bangor and Kahtadin Iron Works Railway; Bangor and Piscataquis; Burlington and Lamoille; Canada Atlantic; Central Vermont; Cheshire; Concord; Connecticut River; Danbury and Norwalk; Eastern; Hartford and Connecticut Valley; Hartford and Connecticut Western; Housatonic; Knox and Lincoln; Maine Central; Milford and Woonsocket; Missisquoi; Narragansett Pier; Naugatuck; New Brunswick; New Haven and Derby; New Haven and Northampton Company; New London and Northern; Newport and Wickford; New York and New England; New York, New Haven and Hartford; New York, Providence and Boston; Northern Adirondack; Norwich and Worcester; Ogdensburg and Lake Champlain; Passumpsic; Portland and Ogdensburg; Portland and Rochester; Providence and Springfield; Providence and Worcester; Providence, Warren and Bristol; Rumford Falls and Buckfield; Shepaug; Somerset; South-eastern; South Manchester; Worcester, Nashua and Rochester.

Boston Passenger Committee.

D. J. Flanders, Chairman, Boston, Mass.
N. E. Weeks, Secretary, Boston, Mass.

Companies.—Boston and Albany; Boston and Lowell; Boston and Maine; Fitchburg; New York and New England; Old Colony; Boston, Revere Beach and Lynn.

New York and Boston All-Rail and Sound Lines Association.

C. T. Hempstead, President, New York.
O. L. Johnson, Secretary, Norwich, Conn.

Lines.—New York, New Haven and Hartford (all-rail lines); Fall River Line—Old Colony; Old Colony Steamboat Company; Stonington Line—Boston and Providence; New York, Providence and Boston; Providence and Stonington Steamship Company; Norwich Line—New York and New England; Norwich and New York Transportation Company.

New England General Ticket and Passenger Agents' Association.

F. H. Kingsbury, President, Keene, N. H.
C. A. Waite, Secretary, Worcester, Mass.

All passenger transportation lines in New England represented.

MIDDLE AND WESTERN STATES.

New York State Passenger Association.

Isaiah S. Emery, Chairman, Rochester, N. Y.
S. F. Pierson, Vice-Chairman, New York City.
Edson J. Weeks, Secretary, Buffalo, N. Y.

Buffalo, New York and Philadelphia; Buffalo, Rochester and Pittsburgh; Delaware and Hudson Canal Company; Delaware, Lackawanna and Western; Elmira, Cortland and Northern; Grand Trunk; Lehigh Valley; Northern Central; New York; Lake Erie and Western; New York Central and Hudson River, New York, Ontario and Western; Rome, Watertown and Ogdensburg; Syracuse, Geneva and Corning; West Shore.

Buffalo Railway Passenger Committee.

P. C. Doyle, Chairman.
Edson J. Weeks, Secretary.

Office, Room 14, Exchange Building, 202 Main St., Buffalo, N. Y.

Buffalo, New York and Philadelphia; Delaware, Lackawanna and Western; Grand Trunk; Lake Shore and Michigan Southern; Lehigh Valley; Michigan Central; New York, Chicago and St. Louis; New York Central and Hudson River; New York, Lake Erie and Western and New York, Pennsylvania and Ohio; Northern Central; West Shore (New York Central and Hudson River, lessee).

Middle States Freight Traffic Association.

John Whittaker, Pres., 243 South Fourth St., Philadelphia, Pa.
Newton R. Turner, Sec., 1415 Walnut Street, Philadelphia, Pa.
Samuel Goodman, Vice-Pres., Grand Central Depot, New York.

Allegheny Valley; Baltimore and Ohio; Baltimore and Philadelphia; Boston, Hoosac Tunnel and Western; Bradford, Bordell and Kinzua; Bradford, Eldred and Cuba; Buffalo, New York and Philadelphia; Buffalo, Rochester and Pittsburgh; Camden and Atlantic; Catasauqua and Fogelsville; Central Railroad of New Jersey; Cornwall and Lebanon; Cumberland Valley; Delaware and Hudson Canal; Delaware, Lackawanna and Western; Elmira, Cortland and Northern; Fall Brook Coal Company; Geneva, Ithaca and Sayre; Gettysburg and Harrisburg; Lackawanna and Pittsburgh; Lehigh and Hudson River; Lehigh Valley; Montrose; New York Central and Hudson River; New York, Lake Erie and Western; New York, Ontario and Western; New York, Susquehanna and Western; Northern Central; Ogdensburg and Lake Champlain; Pennsylvania; Philadelphia, Wilmington and Baltimore; Philadelphia and Reading; Philadelphia and Atlantic City; Rome, Watertown and Ogdensburg; Shenandoah Valley; Southern Central; Troy and Boston; Utica and Black River; Western Maryland; West Jersey; West Shore; Williamsport and North Branch; Williamstown and Delaware River; Wilmington and Northern.

The Middle and Western States Freight Association.

J. M. Osborn, Chairman, Toledo, Ohio.
William Orr, Secretary, Toledo, Ohio.

Allegheny Valley; Baltimore and Ohio; Buffalo, New York and Philadelphia; Buffalo, Rochester and Pittsburgh; Chicago and Atlantic; Chicago and Eastern Illinois; Chicago and Grand Trunk; Chicago and West Michigan; Cincinnati, Hamilton and Dayton; Cincinnati, Indianapolis, St. Louis and Chicago; Cincinnati and Muskingum Valley; Cincinnati, Van Wert and Michigan; Cincinnati, Wabash and Michigan; Cincinnati, Washington and Baltimore; Cleveland, Columbus, Cincinnati and Indianapolis; Cleveland, Lorain and Wheeling; Cleveland, Akron and Columbus; Cleveland and Marietta; Columbus, Hocking Valley and Toledo; Dayton and Union; Detroit, Grand Haven and Milwaukee; Detroit, Lansing and Northern; Detroit, Mackinac and Marquette; Dunkirk, Allegheny Valley and Pittsburgh; Evansville and Terre Haute; Flint and Pere Marquette; Fort Wayne, Cincinnati and Louisville; Grand Rapids and Indiana; Grand Trunk (Great Western division); Indianapolis and St. Louis; Indiana, Bloomington and Western; Jeffersonville, Madison and Indianapolis; Lake Erie and Western; Lake Shore and Michigan Southern; Louisville and Nashville (St. Louis and Louisville, Cincinnati and Lexington division); Louisville, Evansville and St. Louis; Louisville, New Albany and Chicago; Michigan Central; Michigan and Ohio; New York, Chicago and St. Louis; New York, Lake Erie and Western (lessee, New York, Pennsylvania and Ohio); Ohio and Mississippi; Ohio River; Ohio Southern; Pennsylvania Company; Pittsburgh and Lake Erie; Pittsburgh and Western; Pittsburgh, Cincinnati and St. Louis; Peoria, Decatur and Evansville; Toledo and Ohio Central; Toledo, Ann Arbor and North Michigan; Toledo, Cincinnati and St. Louis; Toledo, Peoria and Western; Valley; Vandalia Line (Terre Haute and Indianapolis); Wabash, St. Louis and Pacific; Wheeling and Lake Erie.

Middle States Lumber Association.

J. C. Guthrie, Commissioner, Columbus, Ohio.

Baltimore and Ohio; Cincinnati, Hamilton and Dayton and Dayton and Michigan; Cincinnati, Washington and Baltimore; Cleveland, Columbus, Cincinnati and Indianapolis; Cleveland, Mt. Vernon and Delaware; Columbus and Cincinnati Midland; Columbus, Hocking Valley and Toledo; Indiana, Bloomington and Western; New York, Chicago and St. Louis; Toledo and Ohio Central; Toledo, Columbus and Southern; Wheeling and Lake Erie.

Iron Ore Pool.

J. A. Kingsbury, Ore Pool Agent, Cleveland, Ohio.

Baltimore and Ohio; Lake Shore and Michigan Southern; New York, Lake Erie and Western; Pennsylvania Company; Pittsburgh and Lake Erie; Pittsburgh and Western.

SOUTHERN AND SOUTH-WESTERN STATES.

Southern Passenger Association.

Mercer Slaughter, Commissioner, Atlanta, Ga.

Atlantic Coast Line; Atlanta and West Point; Alabama Great Southern; Brunswick and Western; Charleston and Savannah; Central (of Georgia); Cincinnati, New Orleans and Texas Pacific; Cincinnati, Selma and Mobile; East Tennessee, Virginia and Georgia; Georgia; Georgia Pacific; Illinois Central; Jacksonville, Tampa and Key West; Louisville and Nashville; Louisville, New Orleans and Texas; Memphis and Charleston; Mississippi and Tennessee; Mobile and Ohio; Nashville, Chattanooga and St. Louis; New Orleans and North-eastern; Norfolk and Western; Pennsylvania; Port Royal and Augusta; Richmond and Allegheny; Richmond and Danville; Richmond, Fredericksburg and Potomac; Rome; Savannah, Florida and Western; Seaboard and Roanoke; Shenandoah Valley; South Carolina; Vicksburg and Meridian; Western and Atlantic; Western (of Alabama).

Associate Roads of Kentucky, Tennessee, and Alabama.

M. H. Smith, Chairman of Board of Control, Louisville, Ky.
James R. Ogden, Commissioner, Louisville, Ky.

Alabama Great Southern; Cincinnati, New Orleans and Texas Pacific; Knoxville and Ohio; Louisville and Nashville; Memphis and Charleston; Mobile and Ohio; Nashville, Chattanooga and St. Louis; New Orleans and North-eastern; South and North Alabama; Vicksburg and Meridian.

Associated Railways of Virginia and the Carolinas.

Sol. Haas, Traffic Manager, Richmond, Va.

Advisory Board.—H. Walters, general manager of Atlantic Coast Line; E. B. Thomas, general manager of Piedmont Air Line; John M. Robinson, president of Seaboard Air Line.

Atlantic Coast Line.—Richmond and Petersburg; Petersburg; Wilmington and Weldon; Wilmington, Columbia and Augusta; North-eastern; Cheraw and Darlington; Cheraw and Salisbury; Midland North Carolina; Albemarle and Raleigh.

Richmond and Danville Railroad System (Piedmont Air Line), composed of Atlanta and Charlotte Air line; Charlotte, Columbia and Augusta; Columbia and Greenville; Cheraw and Chester; Chester and Lenoir; Elberton; North-eastern of Georgia; North Carolina and branches; Richmond and Danville and branches; Richmond, York River and Chesapeake; Spartanburg, Union and Columbia; Virginia Midland; Western North Carolina; Washington and Ohio.

Seaboard Air Line.—Carolina Central; Raleigh and Gaston; Raleigh and Augusta Air Line; Seaboard and Roanoke.

Texas Traffic Association.

J. Waldo, Commissioner, Houston, Texas.
George Maclaine, Secretary, Houston, Texas.
J. C. Zimmer, Auditor, Houston, Texas.

Executive Committee.—J. Waldo, chairman; W. Snyder, C. Dillingham, S. H. H. Clark, A. C. Hutchinson, John C. Brown, L. A. Sheldon, S. W. Fordyce, M. G. Howe.

Companies.—Gulf, Colorado and Santa Fe; Houston and Texas Central; Houston, East and West Texas and Shreveport and Houston; Missouri Pacific (in Texas); Southern Pacific (in Texas); St. Louis, Arkansas and Texas (in Texas); Texas Central; Texas and Pacific (in Texas).

TRANSCONTINENTAL TRAFFIC.

Transcontinental Association.

L. G. Cannon, General Agent and Auditor, San Francisco, Cal.

Atchison, Topeka and Santa Fe; Atlantic and Pacific; Burlington and Missouri River; Central Pacific; Denver and Rio Grande; Denver and Rio Grande Western; Galveston, Harrisburg and San Antonio; Northern Pacific; Oregon Railway and Navigation; Oregon Short Line; Southern Pacific; Texas and Pacific; Union Pacific.

NORTH-WESTERN AND WESTERN ASSOCIATIONS.

Western States Passenger Association.

John N. Abbott, Chairman, Chicago, Ill.

Burlington, Cedar Rapids and Northern; Central Iowa; Chicago and Alton; Chicago and North-western; Chicago, Burlington and Northern; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Chicago, St. Paul, Minneapolis and Omaha; Green Bay, Winona and St. Paul; Hannibal and St. Joseph; Illinois Central; Kansas City, St. Joseph and Council Bluffs; Milwaukee and Northern; Milwaukee, Lake Shore and Western; Minneapolis and St. Louis; Minnesota and North-western; Missouri Pacific; Rock Island and Peoria; Sioux City and Pacific; Wabash Western; Wisconsin Central lines.

Western Trunk Line Association.

E. P. Vining, Commissioner, Chicago, Ill.

Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Union Pacific; Wabash, St. Louis and Pacific.

North-western Freight Association.

J. N. Faithorn, Commissioner, Chicago, Ill.

Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Burlington, Cedar Rapids and Northern; Wabash, St. Louis and Pacific; Chicago, Burlington and Northern; Chicago and North-western; Chicago, Burlington and Quincy; Central Iowa; Wisconsin Central; Minnesota and North-western; Chicago, St. Paul, Minneapolis and Omaha; Minneapolis and St. Louis; Illinois Central; Rock Island and Peoria; St. Louis, Keokuk and North-western.

Western Traffic Association.

J. N. Faithorn, Commissioner, Chicago, Ill.

Burlington and Missouri River; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago and North-western; Chicago, Rock Island and Pacific; Chicago, St. Paul, Minneapolis and Omaha; Kansas City, St. Joseph and Council Bluffs; Missouri Pacific; Sioux City and Pacific and Fremont, Elkhorn and Missouri Valley; Union Pacific; Wabash, St. Louis and Pacific.

Cedar Rapids Association.

J. N. Faithorn, Commissioner, Chicago, Ill.

Burlington, Cedar Rapids and Northern; Chicago and North-western; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific.

Clinton, Fulton and Lyons Association.

J. N. Faithorn, Commissioner, Chicago, Ill.

Chicago and North-western; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul.

Davenport, Rock Island and Moline Association.

J. N. Faithorn, Commissioner, Chicago, Ill.

Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Rock Island and Pacific.

Chicago Railroad Association.—Passenger Department.

W. E. Davis, President, Chicago, Ill,
Charles H. Grant, Secretary, Chicago, Ill.

Baltimore and Ohio; Chicago and Alton; Chicago and Atlantic; Chicago and Eastern Illinois; Chicago and North-western; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Chicago, St. Louis and Pittsburgh; Illinois Central; Lake Shore and Michigan Southern; Louisville, New Albany and Chicago; Michigan Central; New York, Chicago and St. Louis; Pittsburgh, Fort Wayne and Chicago; Wabash, St. Louis and Pacific.

The Burlington-Wabash Traffic Association,

J. T. Ripley, Commissioner, Chicago, Ill.
R. T. S. Lowell, Auditor, Chicago, Ill.

Burlington and North-western; Chicago, Burlington and Kansas City; Chicago, Burlington and Quincy; Chicago, Rock Island and Pacific; Central Iowa; Hannibal and St. Joseph; Kansas City, St. Joseph and Council Bluffs; Quincy, Missouri and Pacific; Toledo, Peoria and Western; Wabash, St. Louis and Pacific.

Eau Claire and Chippewa Falls Association.

G. L. Carman, Commissioner, 15 Lakeside Building, Chicago, Ill.

Chicago and North-western; Chicago, Milwaukee and St. Paul; Chicago, St. Paul, Minneapolis and Omaha; Wisconsin Central lines.

Central Iowa Traffic Association.

G. L. Carman, Commissioner, 15 Lakeside Building, Chicago, Ill.

Chicago and North-western; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Chicago, St. Paul and Kansas City; Wabash, St. Louis and Pacific.

Sioux City Association.

G. L. Carman, Commissioner, 15 Lakeside Building, Chicago, Ill.

Chicago and North-western; Chicago, Milwaukee and St. Paul; Chicago, St. Paul, Minneapolis and Omaha; Illinois Central; Sioux City and Pacific.

Marshalltown Association.

G. L. Carman, Commissioner, 15 Lakeside Building, Chicago, Ill.

Chicago and North-western; Chicago, Burlington and Quincy; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Central Iowa; Wabash, St. Louis and Pacific; Wisconsin, Iowa and Nebraska.

Chicago and Ohio River Pool.

L. D. Richardson, Commissioner, 185 Dearborn St., Chicago, Ill.
B. E. Hand, Secretary, 185 Dearborn, St., Chicago, Ill.

Chicago and Eastern Illinois; Chicago, St. Louis and Pittsburgh; Cincinnati, Hamilton and Dayton; Cincinnati, Indianapolis, St. Louis and Chicago; Illinois Central; Indiana, Bloomington and Western; Jeffersonville, Madison and Indianapolis; Louisville, New Albany and Chicago.

Iowa Railway Passenger Association.

J. P. Nourse, President, Marshallown, Iowa.
W. T. Block, Vice-President, Des Moines, Iowa.
J. E. Hannegan, Secretary, Cedar Rapids, Iowa.

Burlington and North-western; Burlington and Western; Burlington, Cedar Rapids and Northern; Central Iowa; Chicago and North-western; Chicago, Burlington and Kansas City; Chicago, Burlington and Quincy; Chicago, Iowa and Dakota; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Chicago, St. Paul and Kansas City; Chicago, St. Paul, Minneapolis and Omaha; Des Moines and Fort Dodge; Kansas City, St. Joseph and Council Bluffs; Minneapolis and St. Louis; St. Louis, Keokuk and North-western; Sioux City and Pacific; Southern Kansas; Wabash, St. Louis and Pacific.

Kansas General Passenger and Ticket Agents' Association.

O. P. McCarty, Chairman, Omaha, Neb.
G. W. Duback, Secretary, Lawrence, Kan.

Atchison, Topeka and Santa Fe; Burlington and Missouri River; Kansas City, Fort Scott and Gulf; Missouri Pacific; St. Joseph and Grand Island; St. Louis, Fort Scott and Wichita; Union Pacific; Wichita and Western.

Western Association of General Passenger and Ticket Agents.

Officers of the Association.—H. M. Bronson, president, Indianapolis, Ind.; J. S. Lazarus, vice-president; Indianapolis, Ind.; J. E. Hannegan, secretary, Cedar Rapids, Ia.

Executive Committee.—J. P. Nourse, Marshalltown, Ia.; B. F. Horner, Cleveland, O.; W. T. Block, Des Moines, Ia.; C. P. Atmore, Louisville, Ky.; H. C. Townsend, St. Louis, Mo.

Board of Arbitration.—F. Chandler, St. Louis, Mo.; C. H. Rockwell, Cincinnati, O.; A. F. Merrill, Milwaukee, Wis.

Iowa, Minnesota, and Dakota Association.

G. L. Carman, Commissioner, 15 Lakeside Building, Chicago, Ill.

Burlington and North-western; Burlington and Western; Burlington, Cedar Rapids and Northern; Central Iowa; Chicago and North-western; Chicago, Burlington and Kansas City; Chicago, Burlington and Northern; Chicago, Burlington and Quincy; Chicago, Iowa and Dakota; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Chicago, St. Paul and Kansas City; Chicago, St. Paul, Minneapolis and Omaha; Des Moines and Fort Dodge; Des Moines, Osceola and Southern; Illinois Central; Minneapolis and St. Louis; Minnesota and North-western; Missouri, Iowa and Nebraska; Rock Island and Peoria; St. Louis, Des Moines and Northern; Sioux City and Pacific; Wabash, St. Louis and Pacific.

St. Paul and Minneapolis Passenger Association.

Charles S. Fee, President, St. Paul, Minn.
S. F. Boyd, Vice-President, Minneapolis, Minn.
P. A. Rockwell, Secretary.

General ticket office, St. Paul and Duluth R. R., St. Paul, Minn.

Chicago, Milwaukee and St. Paul; Chicago, St. Paul, Minneapolis and Omaha; Chicago, Burlington and Northern; Diamond Jo Line Steamers; Minneapolis and St. Louis; Minneapolis and Pacific; Minnesota and North-western; Union Pacific; St. Louis and St. Paul Packet Company; St. Paul and Duluth; Wisconsin Central line.

PRACTICAL EFFECTS OF CONFEDERATIONS.

DIVERSITY OF POWERS AND SYSTEMS.

THERE was a considerable variation in the scope of the operations of the associations named above and their method of operations. Some related to passenger business exclusively and others only to freight. Some grappled with all the problems raised by competitive traffic, and others with only the less intricate and perplexing issues raised. A full recital of all their proceedings would fill many pages, and it is useless to attempt here more than a brief discussion of some of the most important of their aims, methods of promoting them, and results achieved.

At an early stage of the development of the Southern Railway and Steamship Association its affairs were placed under the general direction of

ALBERT FINK,

who had previously been a leading official of the Louisville and Nashville Railroad. He conducted them successfully for a comparatively brief period, when he resigned, and soon afterwards became general commissioner of the Trunk-Line Commission.

In view of the important part Mr. Fink has taken in practically putting in operation the first of the important confederations, and in subsequently acting during a protracted period as the official head of the most important of such bodies, he holds a front rank among those who have labored to establish and render successful schemes for the avoidance of excessive railway competition.

He has frequently given expression to his leading ideas on this subject, and freely outlined them in connection with the deliberations of the Southern Railway and Steamship Association, his description of its workings, and subsequent addresses to the participants of the Trunk-Line Commission. He may or may not, during his extensive experience, have discovered reasons for qualifying some of his utterances. They present, in the aggregate, a notable defence of pooling systems, when they are properly conducted and organized for the purpose of promoting proper objects, and a series of frank utterances, which lay bare the evils that should be averted. These evils are of a two-fold nature, consisting, first, of wrongs inflicted on owners and creditors of railway property through the conducting of transportation at sums below cost; and, second, wrongs inflicted upon various classes of shippers and communities through bargains which lead to or represent unjust discriminations against individuals or sections. Nothing is easier than to declaim against such things, but it is only by a searching analysis of their cause, nature, and extent, and a faithful application of the best remedies suggested by elaborate study and experience that they can be prevented.

HOW COMPETITIVE TRANSPORTATION BUSINESS WAS TRANSACTED BEFORE POOLING ARRANGEMENTS WERE ESTABLISHED.

In an address made to the Southern Railway and Steamship Association, in April, 1876, by Mr. Fink, on the occasion of severing his connection with that organization, he said:—

"The mode in which competitive business between transportation companies is generally transacted is well known, but must be referred to here to show how little reason and intelligence, honesty and fairness is brought to bear upon the management of so important a property as that owned by the transportation companies. A number of competing lines agree upon certain rates to be charged by each, and pledge themselves to strictly maintain the same. There may be some of the managers of these lines who honestly mean to carry out the agreement, but generally there are others who make agreements with the intention to break them, and merely for the purpose of taking advantage of the more honest. . . . The fact that these agreements are hardly ever carried out has been fully established by past experience. The managers have no longer confidence that they can ever be carried out, and there seems to be a tacit understanding that agreements to restore and maintain rates, after a period during which low rates prevailed, are, in most cases, merely made for the purpose of practicing deception upon each other, starting for a higher scale of rates in order to secure, for a short period at least, some remuneration for the work performed, until low rates are reached again in the natural course of events. This mode of transacting business, *based upon deception and dishonesty, has been elevated into a business principle in the management of railroad property*, and is pronounced by many experienced railroad managers and general freight agents *as the only possible or practicable mode upon which the competitive business can be conducted.* It is hardly necessary here to remark that, if this be true, the proprietors of the railroads need not expect to derive much benefit from their property, especially during times when the transportation facilities of the country are so far beyond its wants, as is at present the case. I believe, however, that it is possible to conduct this business upon correct principles, and thereby save a large portion of the railroad property of the country from ruin, which seems inevitable under the present system of management."

The state of things forcibly described in this extract has extended through thousands of ramifications, and to transactions involving many millions of dollars, not only before confederations were formed, but after they were organized, especially during the frequent periods of their partial disruption, and it is only in a moderate degree, by continued and persistent efforts, that durable improvements have been perfected. The natural effect of all serious difficulties or disagreements between the lines temporarily combined in a given confederation is a reversion, more or less complete, towards a revival of all the evils of unregulated competition. In describing

THE LOGICAL RESULT OF VIOLATIONS OF AGREEMENTS

which are not fortified by elaborate pooling provisions, Mr. Fink, in one of his reports to the Bureau of Statistics, said:—

"Supposing, however, that an agreement relative to the establishment ot competitive rates is made and understood by all parties, should it then appear to one or the other party, after a short experience, that it does not receive as much business as it expected or wanted, and such conclusions are generally arrived at, it either openly repudiates the agreement or more frequently violates it secretly by paying commissions or rebates, or by the use of other means of deception. The other parties may soon suspect that they are not fairly dealt with. This mere suspicion is often considered sufficient for adopting means of self-protection, generally corresponding in character with those the other party employed or is supposed to have employed. The result is that, either openly, more often secretly, by means which are considered dishonorable in the ordinary transactions of life, one competitor is underbidding the other. The rates of transportation fluctuate. They become lower and lower. Influential shippers are frequently favored by low rates, enabling them to secure advantages over their competitors, and to monopolize certain branches of business altogether. All this is done in direct violation of the laws that should govern common carriers. The shippers cunningly encourage dissensions among the agents of competing lines, ingeniously working upon their credulity and suspicion by hints or direct misrepresentation, and hardly ever fail to obtain a reduction in the established rates of transportation which had been agreed upon, and were considered reasonable and proper by all of the competing transportation lines. After a period of low rates, caused by this process of underbidding, during which the railroad companies usually work for less than cost, it is found necessary by them to make another effort to secure remunerative rates, and, if possible, by higher rates to make up for past losses. New conventions are called and held, new agreements formed, and they are violated again, as before, and so on. This history of the management of the transportation business is constantly repeating itself, *to the great injury of the people and the proprietors of the roads.* The general managers or heads of the departments attend generally to the establishment of rates, and make agreements with each other, and to this extent, but no further, this important business may be said to be under their control; but no sooner is it believed that one or the other competing lines has violated the agreement, and tries to deceive, whether this be a fact or not, *the management is of necessity surrendered into the hands of subordinates, the soliciting commission agents,* to whom the general instructions are given to do as others are doing, or supposed to be doing, or *to make any rate they please, no matter how low.* From that time on the general managers and the owners of property have lost all control of it. The result is, *fluctuations in rates, unjust discrimination between shippers in the same locality, or between shippers in different localities.* Rebates are generally paid and special contracts are secretly made, all in direct violation of the law that should govern common carriers. There are other causes which lead to the same result. If a controversy arises between any two or more railroad companies upon any subject whatsoever, and they cannot arrive at a satisfactory adjustment, one or the other party commences a system of warfare upon its opponent by establishing unusually low rates of transportation over its own line, and thus compels the other to conform to the same in the hope of inflicting losses upon it to a greater extent, perhaps, than the amount of money involved in the controversy. . . . That this mode of settling controversies between intelligent people is yet permitted in this civilized age can only be accounted for by the fact that property which is thus being unnecessarily sacrificed, *is not the property of the people who manage it.*"

HOW THE PUBLIC IS INJURED BY RAILWAY WARS.

It is obvious that railway companies are injured when they transact a large amount of difficult and expensive business at rates that fall far below cost. How the public is injured by ruinous temporary reductions of rates is forcibly explained in a portion of the report of Messrs. Allen G. Thurman, E. B. Washburne, and Thomas M. Cooley, dated New York, July 20th, 1882, in which they summed up the conclusions they had reached while acting as an advisory commision on differential rates by railroads between the west and the seaboard. After making elaborate inquiries in the commercial circles most deeply affected by the questions they had considered, they said:—

"We have found, however, in the course of our investigations, that a species of competition has prevailed from time to time *which has brought satisfaction to few persons, if any, and which has resulted in inequalities and disorders greatly detrimental to trade.* Such competition exists when the railroad companies, or those who are permitted to solicit business and to make contracts on their behalf, set out with the determination to withdraw freights from their rivals, and secure them for themselves, at all hazards, and regardless of gain or loss; and when acting upon this determination they throw to the winds all settled rates, and in the desperate strife for business offer any inducement in their power which will secure it. The country not long since had experience of such a season, *and everywhere listened to complaints of the injury which legitimate business suffered from it.* It was said by parties interested in transportation that the inauguration of such a strife put an end for the time to all possibility of calculating from day to day what would be the cost of carriage, and what could be safely paid or wisely accepted for grain, provisions, or other articles, destined to another market by rail. The control of railroad rates, and, to a large extent, of all railroad business, then passed out of the hands of the legitimate and regular corporate managers into the hands of solicitors for fast freight lines and other agents, who made from day to day, and from hour to hour, such terms with those having business as would secure it, but generally made secret terms, that the bargain with one man might not prevent their driving a better bargain with another, as they might find opportunity. Under such circumstances, *persons were favored and localities were favored,* when the object to be immediately accomplished seemed to require it, regardless of the just maxims of legitimate business and of the rules of the common law, which enjoin upon common carriers that they shall deal with all customers upon principles of equity and relative fairness. Legitimate business, it was said, necessarily passes into an unsettled and speculative state while this condition of things exists. Safe and close calculations are impossible. *Transportation becomes cheap, but neither producer nor consumer is certain to reap the profit,* for the middleman cannot calculate upon steadiness in low rates, and as he takes the risk of their being raised upon him, so he is in the best position to appropriate the benefit while they continue. Meantime, railroad profits disappear, and dividends cease to be paid, to the great distress of thousands who rely upon them for their living, and every interest, in any degree dependent on railroad prosperity, must participate in the depression and disaster which accompanies the ownership of railroad shares.

The mere statement of these results is sufficient to show that this is not what in other business is known and designated as competition. *Competition is the life of trade, but this is its destruction. Competition brings health and vigor, and secures equality and fairness, but this paralyzes strength, and makes contracts a matter of secrecy and double dealing.* In competition, the sound dealer, operating upon his own capital and upon well-established credit, has the best chance of success; but in the sort of competition we have mentioned it is found that the bankrupt corporation has the advantage, for its managers, having nothing to lose, may offer rates which solvent roads cannot meet without being dragged into bankruptcy with them. Railroad managers do not concede that this state of things is properly designated competition, but they speak of it as an unnatural condition of railroad hostility; as unreasoning railroad warfare; as competitive strife, rather than competition. It is a state of things that, like a war between nations, from its destructiveness, cannot be a normal condition, but must speedily terminate in peace or in disaster. It has usually been terminated by some common understanding between railroad managers upon a tariff of rates.

But this common understanding, it is urged in some quarters, eliminates competition from the sphere of railroad business, and we escape the evils of competitive strife by embracing those of monopoly. This is denied by railroad managers, who insist that understandings respecting the reasonable management of their business are not only entirely consistent with competition, *but that they are the only means whereby the excessive competition at some points can be prevented from operating oppressively at others.*"

HOW CONFEDERATIONS ENDEAVORED TO CURE THE EVILS OF UNREGULATED COMPETITION.

One of the first and most important steps taken by the Southern Railway and Steamship Association, and all other important combinations of a similar character, was to ascertain the amount and character of the competitive traffic which was to be the subject of regulation. It is astonishing how many of the troubles of the world have their root in ignorance; and vague or exaggerated ideas of the importance of certain classes of traffic, or of the advantages that one company was gaining over another, have been important causes of some of the destructive railway wars waged at sundry times. In such matters nothing is more important than exact information, and the confederations furnished the first agencies for procuring reliable knowledge of the kind needed at the times when its acquisition was most desirable and necessary. It is on such data that the allotments of percentages to each of the competing lines were frequently based; and it is only through accessible, reliable, and continuous reports of the amount of business transacted by each of the parties to an agreement that the practical workings of a compact can be ascertained. In Mr. Fink's farewell address to the southern association he forcibly said: "When we consider that the simple question at issue is to bring about a reasonable and fair distribution of the competitive business at remunerative rates, the only rational mode of solving this question that can be suggested, is for the interested parties to agree first definitely upon a division; to ascertain definitely, by a proper account keeping, whether this division takes place under the adjustment of rates agreed upon, and if not, to readjust the rates from time to time, so as to insure the desired result. When this is done, all motive for strife and ruinous competition is removed."

Even after all desirable information was possessed, it was often exceedingly difficult to secure the assent of the parties interested to any of the divisions of traffic proposed, and a resort to arbitration was frequently necessary. These adjustments were indeed a frequent source of great difficulty. Presuming this matter to be adjusted, the division of the traffic originating at various points, or at all important competitive traffic centres, renewed old contests and furnished a fruitful source of bickerings, most of which were finally quieted by definite agreements reached through appeals to arbitrators or otherwise. Another cause of strife was the settlement of accounts in the numerous cases where the amount of traffic carried by each line did not correspond with the agreed division, being either above or below the exact percentage. Various remedial methods were adopted by different associations; sums corresponding to the profits earned being paid in some cases by the lines which had transacted more than their allotted share of business to the lines which had not secured their allotted percentage; attempts to divert traffic from one line to another being made in other cases; and alterations in the amount of differentials or authorized rate cutting allowed to inferior lines being made from time to time by some of the confederations. Interwoven to an important extent with such labors were the adjustments of rates between given points, and of the relation which the rates to or from one point should bear to the rates between other points; and also the gradual improvement of the systems of classification, which regulated the relation of different articles to each other with respect to the amount of freight charges to be paid.

So far as

UNJUST DISCRIMINATIONS AGAINST LOCALITIES

are concerned, the confederations provided the only effective method that has ever been devised for preventing gross inequalities; as the rates to and from each important point reached were necessarily adjusted with at least approximate justice, or the nearest approach to it that was attainable in view of the variety of conflicting interests. In a broad national sense there has never been any other serious effort to prevent unjust discriminations against numerous competitive localities than that represented by the labors of the confederations in this direction. They have, in the aggregate, formed the only tribunals ever established in this country which were at once capable of discussing this subject intelligently, of securing the prompt attention of representatives of the diverse interests, and of giving practical effect to such conclusions as were reached after due deliberations. Nobody knows so well as the representatives of the railway lines that traverse diverse competitive sections and reach numerous competitive points what unjust discriminations against localities are; attempts to practice them are sure to encounter resistance, perhaps even to the extent of precipitating damaging railway wars; and it is questionable whether any other rational mode of permanently adjusting the rates to and from numerous cities in the United States on an approximately just basis has ever been even suggested, except that represented by the labors of some of the confederations, and kept in force when they were in harmonious operation.

Some of the most injurious and protracted of the railway wars that have occurred in this country have been waged for the purpose of settling by damaging conflicts the relation that should exist between the rates to and from rival cities. The struggles in reference to the relative rates between Boston, New York, Philadelphia, and Baltimore, respectively, on the one hand, and western or north-western traffic centres on the other, were exceptionally severe, it being the object of the northern trunk lines or New York Central and Erie to diminish or annihilate the differentials or right to make lower rates to Philadelphia and Baltimore than to New York, and the object of the Pennsylvania and Baltimore and Ohio trunk lines which traversed a more southern latitude to prevent the annihilation of the practical right to move through western freight to and from Philadelphia and Baltimore, at slightly lower rates than those accorded to the city of New York. Similar controversies have occurred in regard to the relative rates affecting other cities, and there are always influences at work which have a tendency to incite such conflicts between or about sundry rival cities. One of the great tasks of the important confederations, at various periods, was to avert such struggles. The means adopted was to elaborately consider the intricate questions involved, and finally agree upon a percentage of rates or basis of percentages between all competitive points in the territory over which jurisdiction was exercised. These percentage tables were slightly altered from time to time when special reasons for changing them in any particular were shown. In regard to the rates between the north Atlantic seaports and territory east of the Mississippi and north of the Ohio river, a brief account of the method pursued is furnished in the following extracts from statements made by Mr. Fink to select committee on interstate commerce of the United States senate on May 21st, 1885:—

RULE FOR ADJUSTING RATES BETWEEN ALL THE COMPETITIVE POINTS IN A GIVEN TERRITORY.

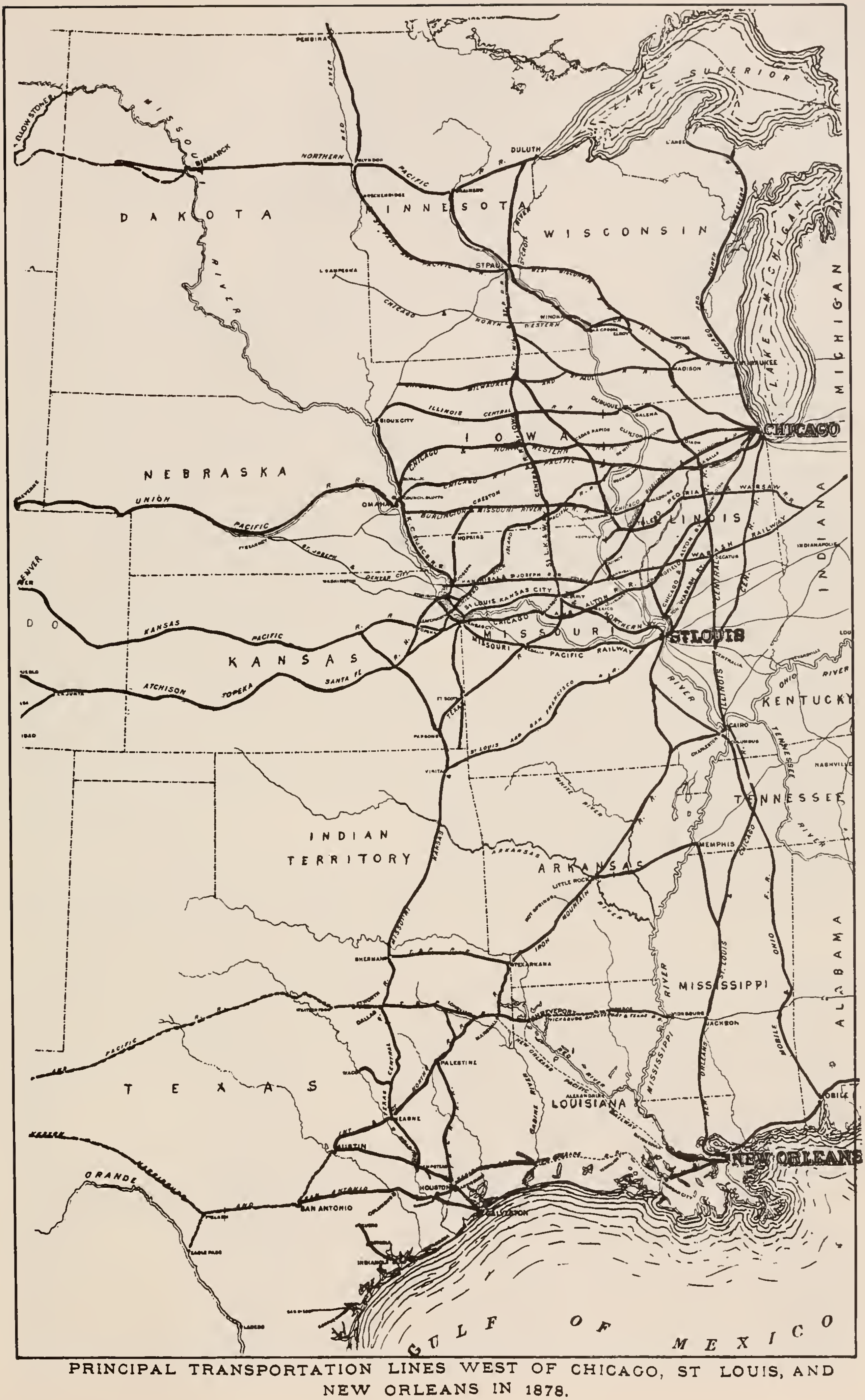
"The main rule that prevails in this section of country for making tariffs is a very simple one, and it has been a satisfactory one. The rates between Chicago and New York, which are generally determined by the competing water routes, are taken as the basis of the tariff. When that is established, a table which has been prepared, based upon the relative distances of other points to points of destination of the freight, gives the corresponding rates from other cities east of the Mississippi river and north of the Ohio river.

The Chairman. You mean all the stations along the road?

Mr. Fink. I mean all the important competitive points.

The Chairman. Can you furnish that table to us?

Mr. Fink. Yes, sir. Here is the percentage table agreed to. This is the result of the efforts of these competing roads during the last ten years to establish a proper tariff, *to avoid unjust discrimination between the various localities in the west.* The rates from the competing points to common points in the east, say



PRINCIPAL TRANSPORTATION LINES WEST OF CHICAGO, ST LOUIS, AND NEW ORLEANS IN 1878.

New York, are in proportion to the distance from Chicago to New York. For example, Cairo, Illinois, is 120 per cent. of Chicago. It is 1,200 miles from New York, while Chicago is about 1,000 in round numbers. Whenever the rate from Chicago to New York has been established, the rate from Cairo to New York is 20 per cent. higher. Take Indianapolis for another example. Its distance from New York is 93 per cent. of the distance from Chicago to New York. Whenever the rate is reduced from Chicago to New York from 25 cents to 20 cents per 100 pounds, the rate from Indianapolis is at once reduced to 23 per cent. of the twenty-cent rate, or 18½ cents.

The Chairman. Recognizing the distance as that much less?

Mr. Fink. The relative distance between points between which freight is to be carried is made the basis of the tariff—substantially so. There are sometimes a great many routes of different lengths between common points, and rates may sometimes be based upon the long, sometimes on the short, and sometimes on the average length of the several routes.

The Chairman. While you are regulating freights on a road from here to Chicago, for instance, you begin at Chicago to charge so much from there to New York, or from New York to Chicago, and you do the same thing as to every other point where there is another road that comes this way? You let each one of the roads cut and carve at every station where there are not two roads, do you?

Mr. Fink. No, there are certain rules upon which tariffs are made from local points. After a rate has been established for a competing point, say for Indianapolis, it being 93 per cent. of Chicago, then the rate from a point beyond Indianapolis (if it is not a competing point, but a local point on any one of the various roads that run to Indianapolis), is added to the through rate. The local rate, which is generally for short distances, can only be charged to the point where the freight reaches the first competing point. The roads can never do more than that. And here I would call your attention to this fact: That high local rates can only be made for short distances. For example, I suppose in Illinois there is no place more than 10 or 20 miles from some competing railway station. In such a case the local rates could only be made high for 20 miles. As soon as the freight strikes a competing point, and it is intended to go beyond that point, it gets the advantage of whatever low rates may exist from that point. The local shipper has the full advantage of competing rates."

THE PERCENTAGE TABLE

referred to above, which indicated the relation between rates pertaining to all competitive points in a given territory, named several hundred places, alphabetically, including a number of towns containing a comparatively small population, as well as important cities. The following extract from the first portion of a revised table of east-bound percentages adopted to take effect June 1st, 1883, sufficiently indicates their character:—

To New York.	Per ct.
Adrian, Mich	92
Akron, O	71
Alida, Ind	100
Alexandria, Ind	92
Allegan, Mich	100
Alton, Ill	116
Anderson, Ind	92
Arcadia, O	79
Argos, Ind	100
Athens, O	78
Auburn, Ind	92
Auburn Junction, Ind	92
Avilla, Ind	92
Battle Creek, Mich	100
Bellefontaine, O	83
Bloomington, Ill	109
Bunker Hill, Ind	97
Burgoon, O	78
Butler, Ind	92
Cairo, Ill	120
Cambridge, O	74
Cambridge City, Ind	90
Canton, O	71
Casey, O	79
Cassopolis, Mich	100
Cecil, O	85
Celina, O	85
Charlotte, Mich	95
Chicago, Ill	100
Chillicothe, O	80
Cincinnati, O	80
Circleville, O	80
Claypool, Ind	97
Cleveland, O	71
Clyde, O	78
Columbia City, Ind	93
Columbus, O	77
Connersville, Ind	90
Continental, O	83
Crawfordsville, Ind	100
Crestline, O	76
Creston, O	71
Crown Point, Ind	100
Dayton, O	84
Decatur, Ind	90
Defiance, O	85
Delaware, O	77
Delphos, O	83
Deshler, O	80
Detroit, Mich	78
Dunreith, Ind	90
East St. Louis	116
East Burlington, Ill	116
East Hannibal, Ill	116
East Keokuk, Ill	116
East Louisiana, Ill	116
Elkhart, Ind	100
Elwood, Ind	95
Enterprise, O	85
Erie, Pa	60
Evansville, Ind	108
Findlay, O	79
Forest, O	79
Fort Wayne, Ind	90
Fostoria, O	78
Fox, Ind	90
Frankfort, Ind	96
Fremont, O	78
Galion, O	76
Gallipolis, O	87
Goshen, Ind	97
Grand Rapids, Mich	100
Granger, Ind	100
Green Castle, Ind	100
Greenfield, O	83
Greenville, O	85
Greensburg, Ind	93
Green Springs, O	78
Hagerstown, Ind	90
Hartford City, Ind	90
Harvard, Ill	114
Hillsboro, O	87

While the difference in the percentage of rates to and from western points to New York is shown in the above table, rules were also laid down to govern movements to Philadelphia, Baltimore, and Boston. The rule relating to this subject, which was adopted in 1879, and applied to a percentage table similar to that described above, was as follows:—

"Adjust rates to Boston, Philadelphia, Baltimore, &c., as follows, viz.:—

To Boston, and to points taking Boston rates, *add* five cents per hundred to the rates to New York; to Philadelphia, and points taking Philadelphia rates, *deduct* two cents per hundred from the rates to New York, and to Baltimore, and points taking Baltimore rates, *deduct* three cents per hundred from the rates to New York."

Corresponding arrangements were made for establishing a basis of rates on west-bound traffic which originated in all the north Atlantic seaboard cities and adjacent points.

In the numerous cases where confederations of lines traversing other regions made analogous arrangements, it became a comparatively simple matter to regulate rates with approximate precision, and to avoid discriminations against localities to an analogous extent. The net result was the power to promptly quote approximately just rates between nearly all the competitive points in all portions of the country, which were substantially adhered to at all times when the pooling systems applicable to the points named were in successful operation. A comparatively close approach was thus made, during eras when railway wars and undercutting were avoided, to the ideal system of transportation which E. Porter Alexander describes as "one in which any shipper might sit quietly in his office, and contract to deliver freight at any town in the United States by referring to a printed tariff, which would show rates as uniform to all as the rates of postage, and not exorbitant in amount."

DISCRIMINATIONS AGAINST INDIVIDUALS.

Effective confederations necessarily led to a notable diminution in the number and injurious characteristics of discriminations against shippers, or in favor of large shippers. While railway wars were of frequent occurrence and competition active, agents of every competing company naturally and inevitably made earnest endeavors to secure the business of firms which habitually desired facilities for the movement of large quantities of freight. It was manifestly the interest of prominent shippers to secure the greatest attainable concessions from agents of the rival companies, and either by direct concessions, a promise of rebates or drawbacks, delusive methods of classification, or false weights, they usually succeeded in having movements made for sums considerably below the prevailing nominal rates. There are so many methods by which strict adherence to rates can be avoided by the joint connivance of transporting companies and the parties they serve that it is practically impossible to prevent such evasions by law, or any other known method than the removal of all inducements or incentives to participation in such evasions by transporting companies. On this account it was found difficult to break up all the disguised forms of rate-cutting which had become deeply rooted at all points where active and unscrupulous competitive efforts had been continued during a protracted period. But many vigorous struggles in a reformatory direction were made. In regard to their results, E. Porter Alexander, writing in 1887, says: "We can now at least judge of the tendency of the pool, and by comparing the present situation with that at its beginning, can decide whether or not there is any palliation of the personal discriminations from which deliverance was sought, and whether or not there are indications of the approaching extortion apprehended by the public.

As to the decrease of personal discriminations, or the prevalence of rebates, there are, of course, no statistics or exact figures to be appealed to, but there are certain indications from which the general situation may be inferred. First, there is little recent public complaint of this evil by shippers. Ten years ago the papers were filled with it, and public meetings were frequently held to denounce it. The indignation would not be less now did it exist to an equal degree. The theorists who from time to time write and declaim against the railroads draw all their examples from dates prior to the establishment of the pool, or from periods when its operations were suspended. The oldest, and, in some respects, the most successful, pool in the United States is that of the Southern Railway and Steamship Association, which covers most of the south Atlantic and gulf states. Before it was established the rates were honeycombed with rebates at every competitive point in the territory. To-day, from some personal knowledge of the situation, and from the best information I can obtain, I do not believe that *there exists a single rebate or personal discrimination in all the pooled business in that territory*. As to the trunk-line pool in New York, it is believed by those most likely to know, or to suspect such things, *that none exist on the part of any trunk lines,* though it is probable that some of the weaker connections still purchase a part of their business in some way. . . . It is certainly clear, then, that the pooling system at least greatly palliates the evils of discrimination and rebates."

CLASSIFICATION OF FREIGHT.

A considerable portion of the proceedings of some of the deliberative bodies organized by the confederations consisted of the discussion of proposed changes in the classification of freight, a number of which were made from time to time. As material differences in rates in force at any period between any points depend upon the class in which articles are ranked, the regulation of such classifications forms one of the most important and complicated portions of the duties of modern railway managers. Its effect on the cost of movements of various kinds of merchandise is analogous to that of a governmental tariff embracing numerous rates of duty on imported articles. The subject abounds with intricacies, which steadily and rapidly increased with the growth of traffic, numerous additions to the list of articles moved extensively, and reductions of average rates to exceptionally low standards. In many instances it would probably be difficult to give satisfactory reasons for putting one article in a class that required the payment of a higher rate than another similar article, but in many other instances there were good reasons for such differences, as they included great variations in value and consequent risk in case of loss or damage and the cost of handling.

Competition of one kind or another forms an invariable feature of all extensive transportation systems, and received much consideration even in the adjustment of the toll sheets of canal lines constructed and owned by states; but as civilization progresses and various complications arise, either through important additions to the list of articles carried, or the effect which the extensive sale of some new product has upon trade conditions existing at the time it was first introduced, such as was produced by extensive internal dressed-meat shipments on live-stock interests, or other causes, the complexity of classifications grows rapidly, and the necessity of frequent authoritative action in reference to sundry products is intensified.

Originally in the internal railway and steamboat freight movements of the country the most important distinctions were based either on the intrinsic value of the articles moved, on the relative ease with which they could be loaded and unloaded, on the relation between their weight and the space they occupied, or on the question whether they were dry goods or groceries moved from cities to the interior, or domestic products moved from the interior to commercial centres. Such considerations still possess much significance, but the extent to which minuteness of distinction has been carried has been greatly magnified, and much has been done in the way of establishing uniformity of freight classifications on the part of the lines traversing a given territory.

In reference to uniformity it is stated that the new trunk-line freight classification which went into effect on April 1st, 1887, a few days before the interstate-commerce act of 1887 became enforcible, and was made applicable to competing points north of the Ohio and east of the Mississippi, partially superseded more than a score of classifications previously in force in the same territory. It specifically superseded the official classification of east-bound freight, the official classification of west-bound freight, the Middle and Western States classification of freight, and the joint merchandise freight classification. It applied to and directly named almost every article of commerce.

Before it was promulgated elaborate rules and special instructions were forwarded to agents, some of the most important of which related to precautions against fraudulent action on the part of shippers in the matter of furnishing a false description of merchandise for the purpose of securing an unauthorized lowering of rates, or intentional mistakes or misstatements relating to weight for the purpose of having a greater quantity of freight carried than the amount for which a charge was made. These two forms of deception, practiced with the connivance of clerks or other officials connected with freight departments, when a railway company or some of its representatives desire to engage in secret rate-cutting, and frequently attempted by shippers, without such connivance, when they believed that detection could be evaded, have formed disturbing influences of considerable magnitude in connection with all attempts to strictly maintain legitimate freight rates, and they bear to the aggregate freight movements of the country a relation somewhat similar to that held by smuggling systems, at various times and periods, to import duties or governmental methods of collecting revenue on merchandise imported from foreign nations.

This is doubtless the most elaborate classification of freight ever made. Some idea of its comprehensiveness may be formed from the fact that the classification and directions interwoven with it which relate to particular descriptions of traffic, such as live-stock movements, for instance, are contained in sixty-eight pages of a closely-printed pamphlet, each of which contains sixty lines, when all their space is occupied with printed matter, but short blanks are left between each of the alphabetical headings.

An illustration of its characteristics is furnished by the following extract, which represents the contents of a little less than the first page:—

CLASSIFICATION.

Explanation of Characters.—The class is given opposite each article, 1, 2, 3, 4, 5, and 6, stand for first, second, third, fourth, fifth, and sixth classes respectively. Sp'l for special. 1½ for once and a half first class. D 1 for double first class. 2½ for twice and a half first class. 3 t 1 for three times first class. 4 t 1 for four times first class. O. R. for owner's risk. O. R. B. for owner's risk of breakage. O. R. C. for owner's risk of chafing. O. R. L. for owner's risk of leakage. C. R. for carrier's risk. S. U. for set up. K. D. for knocked down. C. L. for car load. L. C. L. for less than car load. P. P. for prepaid. N. O. S. for not otherwise specified.

Articles not Enumerated will be Classified with Analogous Articles.

	L. C. L.	C. L.
Acetate of lime	4	5
Acids, in carboys, O. R., released	1	.
Acids, in iron drums, O. R	4	.
Acids, in carboys or iron drums, C. R	D 1	.
Acids, in carboys or iron drums, O. R	..	5
Acids, in tank cars, to be furnished by shippers, O. R., minimum weight, 24,000 pounds; empty tanks to be returned free, no mileage allowed	..	4
Acids, dry, in boxes or kegs	2	.
Acids, dry, in barrels or casks	3	.
Actinolite	4	.
Advertising boards, in bundles	3	.
Advertising matter, boxed or in bundles, O. R., P. P.	1	3
Agate ware	1	4
Agolite	4	5

Agricultural implements and agricultural implement parts, or stock or stuff, as follows, viz.:—

In car loads at owner's risk of breakage or chafing, as follows, viz.:—

When loaded in box cars, N. O. S 5
When loaded on flat cars, shippers to assume risk of loss of small parts, and to so state on bills of lading or shipping bills.........5
When loaded on flat cars, carrier to assume risk of loss of small parts..4
When returned to manufacturers, for repairs via same road by which they were orginally forwarded...................................6
Binders' trucks, for moving and self-binding harvesters............5
Cutter bars and cutting apparatus..5
Cradle bodies, fingers, and snaths 4
Cutters, ensilage...5
Cutters, sod...5
Fanning mill material...5
Harrow teeth...5
Hay rickers, K. D. flat, in bundles...5
Manure spreaders..5
Plows...5
Plow beams and handles, iron or wood..................................5
Rake teeth, iron or steel...5
Rollers, field, garden, or lawn...5
Scythes and scythe snaths..4
Steel plow points and wings...5
One thresher or separator, with steam power.........................5
Two threshers or separators, with or without horse-power.........5
Wheels, wrought iron, for agricultural implements...................5
Wheels, iron and wood combined, for agricultural implements....5

The committee which prepared this classification consisted of F. H. Kingsbury, of the Pennsylvania Railroad; George G. Cockran, of the New York, Pennsylvania and Ohio; William S. Sloan, of the Delaware, Lackawanna and Western; C. S. Wight, of the Baltimore and Ohio; R. L. Crawford, of the New York Central and Hudson River; J. T. R. McKay, of the Lake Shore and Michigan Southern; and N. Guilford (freight commissioner of the trunk-line confederation), chairman.

It was adopted at a meeting of the joint committee (freight department), held in New York on March 2d, at which time the following report of a committee on rates of which Mr. Hayden, of the New York Central, was chairman, was also adopted:—

The committee do not consider it advisable or practicable to establish as a principle that east-bound and west-bound rates shall necessarily be the same, but recommend that, under the conditions now existing, taking effect April 1st, 1887, and until thereafter changed, the rates be:—

New York to Chicago:—

1st.	2d.	3d.	4th.	5th.	6th.
75	65	50	35	30	25

Chicago to New York:—

1st.	2d.	3d.	4th.	5th.	6th.
75	65	50	35	30	25

On the following day the joint committee approved a report which authorized some changes in the percentage table relating to east-bound traffic. On the three vital matters thus arranged or rearranged, for the time being, viz., freight classification, rates, and the percentage table, hinges an immense proportion of the vital essence of modern railway operations and their effect on investors or stock markets on the one hand, and the general public, in their various capacities as consumers, producers, shippers, consignees, and merchants.

PASSENGER POOLS.

In connection with some of the confederations, and especially of the Trunk Line and Central Traffic associations, passenger pools were formed, in which the general passenger agents of the companies interested, or their representatives, met from time to time, under the direction of commissioners or their assistants, to devise means for preventing excessive competition in regard to fares or the charges for moving persons. Of the inception of one of the most important of these movements, Mr. S. F. Pierson, commissioner of the passenger department of the Trunk-Line Commission, writing in 1884, in an article on the Passenger Pool and a Clearing House, contributed to the Chicago Railway Review, said:—

"Recognizing the difficulties of the problem, the joint executive committee, representing most of the important through lines east of Chicago and St. Louis, and north of the Ohio river, entered upon an agreement for the division of certain passenger earnings and traffic, which took effect September 1st, 1882, and continued in force until July 31st, 1884. The general notion of this movement was to divide all the important competitive business in the territory described between competing lines in fixed proportions. The object was to secure, by a general partnership in the total traffic to be transported, stable rates of fare between competitive points, and better net results by reducing to a minimum the expense of soliciting, advertising, commissions, and other fancy expenditure for securing business. It was agreed to submit differences which might arise, and which could not be settled by negotiation, to the adjustment of arbitration. This experiment was at first applied to business passing between the cities of Chicago, St. Louis, and Cincinnati on the west, and Boston and New York on the east. It did not include business passing through either of those points, nor any business to or through a number of important gateways in intermediate territory; nor, until a late period, did it include any of the interior cities. Notwithstanding this, stability in the business actually divided under this arrangement was substantially secured. The balances drawn from month to month were promptly paid, and, with one or two unimportant exceptions, it was found that roads earning their allotted proportion sought neither to reduce fares nor to pay commissions on business which was secured to them without such expense, and that the roads which were obliged to buy their business under any condition of affairs, secured it at less cost under the protection of the contract. The healthful effects of maintenance of rates between these points was felt in other branches of the business. Nevertheless, a few companies declined from the outset to become parties to the arrangement, and their position with reference to it menaced the success of the effort. This, together with the introduction of new roads, which did not become parties to this arrangement, not only made it impracticable to extend it to a greater number of points, but also threatened the roads who were parties to the agreement with the loss of traffic if it should be continued. It was decided impracticable, therefore, to continue the experiment after the month of July until such time as all important roads interested would become parties to it, and until it could be extended to a sufficient number of competitive points to give it a reasonable chance of success. The result is simply a repetition of what has happened many times before. A very large portion of the proper revenues of the roads from competitive passenger business is being wasted, and the end is not yet."

Efforts to prevent the demoralization of passenger traffic, by various means were continued. In a circular furnished to all the roads interested, dated April 13th, 1885, Mr. Pierson said: "Since the division of passenger business was discontinued in July last, the condition relating to the maintenance of rates of fare throughout the territory east of Chicago and St. Louis has been growing constantly worse, until the necessity for prompt and united effort in the interest of revenue is, perhaps, greater than ever before in the history of these railways."

In response to this and numerous other appeals a number of expedients were adopted, in some instances with good effect, and in other cases the results could scarcely be considered satisfactory. The effective regulation of competitive passenger traffic is, if possible, a more difficult task than the regulation of competitive freight movements.

CAUSES OF FREQUENT FAILURES OR TEMPORARY DISRUPTIONS OF CONFEDERATIONS.

Notwithstanding the beneficial results attained, from the railway standpoint, from the successful operation of confederations, the periods during which they were partially or wholly ineffective were numerous. The most important reasons for frequent failures are probably stated in the following extract from Mr. Albert Fink's statements to the Senate committee on interstate commerce, made in New York on May 21st, 1885:—

"The great difficulty that we experience in establishing and maintaining tariffs is to compel all the competing railroads to act together. There are always one or more that labor under the mistaken idea that they could stand outside and take advantage of the roads in the association that bind themselves to publish and maintain tariffs. It is a most short-sighted policy, as it always results in a war of rates and unremunerative rates for all. Unfortunately, there are short-sighted railroad managers that will repeat and repeat the same short-sighted policy, and they are mostly responsible for all the mischief that follows. They cause losses to railroad companies of millions and millions of dollars, and prevent proper adjustment of tariffs. . . . I sometimes despair that we can accomplish anything by voluntary agreement, although this would be the proper way to do. If we cannot, and the Government cannot step in and make these necessary tariff agreements binding in the same way as it enforces all other legitimate contracts, then I do not know what is to become of the railroads of this country. I am just as anxious to formulate a law that would meet this evil as you are, but at the same time I cannot see my way clear to any law that would be effective and operate justly to all interests. I can see my way clear this far: That when railroad companies do come together and publish a tariff, they ought to be made to adhere to it; but the question is how to get them together if one or the other wishes to stay out. I do not exactly know how that can be done, but I would recommend that if any legislation is to be had at all this experiment should be tried of forcing roads to publish and maintain tariffs."

Various causes that have diminished the efficiency of the important railway confederations to a great extent include the following: First, absence of legislation making the agreements reached from time to time enforcible in the courts; second, the development, at various times and places, of forms of popular, commercial, or judicial antagonism; third, the prolonged antecedent training of a large proportion of the men actively engaged in soliciting or superintending freight movements in adroit, zealous, and reckless competitive practices; fourth, intense rivalries prevailing between some of the lines participating in each combination; fifth, the dire financial straits in which companies are sometimes placed when the traffic to be moved falls below the normal standard; sixth, the frequent construction of new lines or formation of new routes between important competitive centres, after a confederation is in successful operation, partly because, on account of the comparative steadiness with which rates are maintained through its labors, it is supposed that satisfactory profits can be reached from participation in the business that has been placed on a paying basis; seventh, because lengthy new lines commonly have little local traffic either to protect or furnish revenue, and they are, therefore, usually disposed to display unusual eagerness in their competitive efforts, and eighth, because the rapid extension of new lines, establishment of new settlements, and creation of new commercial interests in many portions of the country, frequently develop disturbing elements.

Of the adverse influences, the two which were probably the most difficult to surmount were the absence of legal methods for enforcing compacts and the extraordinary ease with which lengthy new competitive lines can be constructed during eras of apparent prosperity. A third of great importance was added by the clause of the interstate-commerce law of 1887 which forbids pooling arrangements that involve the payment of money by one company to another in settlement of balances arising from a failure of any of the participants to secure their allotted percentage of traffic. The last-named obstacle is so serious that if confederations had not proved useful for the classification of freight, the intelligent discussion and adjustment of rates between numerous points, and various other purposes, it would probably have led to their abrogation. It necessarily required that leading features of the most important confederations should be essentially modified.

If the payment of balances arising from the different degrees of success which attend the efforts of competing companies is to be strictly forbidden permanently, the pooling systems will probably fail to accomplish the leading purpose of their existence, unless they can devise differential charges sufficiently flexible and diverse to accomplish the desired results. This would be an exceedingly difficult task, as it would involve the adjustment of a scale of authorized variations from standard tariffs and rate sheets that would approximately meet the requirements of all lines.

A new stage of development commenced with the passage of the interstate-commerce law of 1887, and the appointment of five commissioners, consisting of Messrs. Thomas M. Cooley, of Michigan; William R. Morrison, of Illinois; Augustus Schoonmaker, of New York; Aldace F. Walker, of Vermont, and Walter A. Bragg, of Alabama. It will probably require a considerable amount of time to determine the effect of the powers they are authorized to exercise and of the provisions of the law upon the complications arising from excessive and unregulated competition; and to show how far the plans and labors of confederations or pooling systems will be modified.

It happened repeatedly before the passage of the new law that insurmountable obstacles temporarily prevented the attainment of a semblance of success on the part of some of the important confederations, yet they were not wholly abandoned during the darkest hours of their existence, and usually, after interregnums of varying length, their operations were actively recommenced, and this experience may be repeated.

STEAMSHIP DEVELOPMENT.

THAT proverbially interesting but not always veracious person, the oldest inhabitant, can remember when steamships had to fight their way against criticism, doubt, and avowed hostility. One with a taste for unfulfilled prophecies could find amusement in reading the objections urged against steam navigation, not by owners of sailing vessels, but by naval officers of skill and experience, to whom no one ever attributed interested motives. Commodore Stockton was, by many a weather-beaten seaman, looked upon as men now look on inventors of impracticable machines. J. Fenimore Cooper, in the introduction to his "History of the Navy of the United States of America," says: "There is an opinion becoming prevalent that the use of steam will supersede the old mode of conducting naval warfare. Like most novel and bold propositions, this new doctrine has obtained advocates, who have yielded their convictions to the influence of their imaginations, rather than the influence of reflection. That the use of steam will materially modify naval warfare is probably true, but it cannot change its general character. No vessel can be built of sufficient force and size to transport a sufficiency of fuel, provisions, munitions of war, and guns, to contend with even a heavy frigate, allowing the last to bring her broadside to bear. It may be questioned if the heaviest steam vessel of war that exists could engage a modern two-decked ship even in a calm, since the latter, in addition to possessing much greater powers of endurance, could probably bring the most guns to bear, in all possible positions. Shot-proof batteries might indeed be built that, propelled by steam, would be exceedingly formidable for harbor defence, but it is illusory to suppose that vessels of that description can ever be made to cruise." These are the words of one of the greatest of American writers, of a man who had shared the life of the forecastle and the quarter-deck, yet now they sound like utter nonsense. Ships like those in which Porter wandered over the Pacific, or Brooke captured the Chesapeake, could no more engage an efficient war steamer of to-day than a stage coach could race with a lightning express.

For ages man has ventured on the sea, and it is only within a brief period that the old saying, "Land separates and water connects," has begun to lose its force. Even the rudest savages generally have some light craft, and ancient history is full of allusions to galleys and triremes. The record of how the adventurous Phœnicians crept along the Mediterranean shores; how Scandinavian pirates ravaged the British coasts; how the Spaniards triumphed at Lepanto; how the early explorers traversed our western seas, and how Spain, England, Holland and France wrestled for commercial and naval supremacy, is a grand theme, whether treated as a historical poem or poetic history. But the periods from Jason to Drake, and from Drake to Paul Jones, are, for our purposes, less important than that from Fulton to the present time.

THE FIRST WAR STEAMER.

During the war of 1812 Fulton offered to build the Government a war steamer for $320,000, about the cost of a first-class frigate. The Government accepted his offer, and in 1814 he constructed the first steam man-of-war in the world, a vessel which very properly received his own name. Her tonnage exceeded 2,400; her sides were nearly five feet thick, and her draught ten feet. Credulous Britons formed most exaggerated ideas of her force, but she was in reality no mean foe, her designed armanent being 30 32-pounders and 4 100-pounders. She was launched in 1815, and proved amply able to move at the rate of five miles an hour, slightly more than was required by the contract. In 1829 her magazine exploded, and she perished, with no martial renown, it is true, yet with the dual distinction of having been the first steam man-of-war in the world, and the largest steamer built before 1838. Commander Chadwick deems her "a fitting monument to the genius of the man who unfortunately did not live to see her completion and successful trial."

The idea of building ocean steamers, while dear to the hearts of men like Fulton and Stevens, did not recommend itself favorably to the average shipowner. Steam vessels then moved at a very moderate rate of speed, frequently less than half that sometimes made by ships under sail, and he could see no advantage to be gained, except in calms or against head winds. Cooper says: "It is certain that no steamer, in the present state of science, can remain at sea thirty days, with efficiency as a steamer," and it is probable that many experienced judges shared this conviction. To navigate inland rivers, it might be said, was easy enough, but for a large sea voyage it was safer to put reliance on craft that had proved their fitness for such work.

THE FIRST COMMERCIAL STEAMSHIP.

In 1819 Crockett & Fickett, of New York, launched the Savannah, 380 tons. She was equipped as a full-rigged ship, and provided with a horizontal 90-horse-power engine, with side paddle-wheels and boilers in the hold. The Savannah made a trip to the southern city of that name, and shortly after crossed to Liverpool, making the trip in twenty-five days, during seven of which she was only propelled by the wind. In the summer she visited Cronstadt, and in October returned to the United States. Her machinery was subsequently taken out, and she served as a New York and Savannah packet until lost on the coast of Long Island. On the whole, she was an unsatisfactory ship, but she proved that steam could be utilized in trans-Atlantic voyages.

STEAMSHIP DEVELOPMENT IN ENGLAND.

A number of English companies were formed for the purpose of establishing steam packet communication with all parts of the globe, but most of these projects proved as illusory as the South Sea bubble or the tulip mania. In 1825 the steamer Enterprise, after a voyage of 113 days, reached Calcutta, and was soon followed by others. This led in turn to the establishment of regular steamship lines to France, Spain, the Mediterranean, the East and West Indies, and America. No one now ventured to question the possibility of using steam at sea, yet it still remained a point whether steam alone would be an adequate motive force. Fuel was a very costly item.

Brunel's determination to build a large steamship was fittingly carried out in the Great Western, her dimensions being: Length over all, 236 feet; length between perpendiculars, 212 feet; length of keel, 205 feet; breadth, 35 feet 4 inches; depth of hold, 23 feet 2 inches; draught of water, 16 feet 8 inches; length of engine room, 72 feet; tonnage by measurement, 1,340; displacement at load draught, 2,300; dimensions of engines—diameter of cylinders, 73½ inches; length of stroke, 7 feet; weight of engines, wheels, &c., 310 tons; number of boilers, 4; weight of boilers, 90 tons; weight of water in boilers, 80 tons; diameter of wheel, 28 feet 9 inches; width of floats, 10 feet. Her indicated horse-power was 750. The Great Western was launched at Bristol on July 19th, 1837. On April 4th, 1838, the Sirius left Cork for New York, and four days later the Great Western left Bristol in chase. Both vessels reached New York on 23d day of the month, the Sirius several hours ahead. The Great Western made her return trip in 14 days, and with a coal cousumption of 392 tons, against 655 tons on the outbound voyage. Between 1838 and 1843 she made sixty-four voyages across the Atlantic. In 1847 she was sold to the West India Steam Packet Company, and ten years later she was broken up at Vauxhall.

Mr. Cunard's efforts in establishing regular trans-Atlantic communication will ever be memorable. His company has become a household word. The Great Britain, built by the Great Western company, was the first large iron-hulled ship, although the use of this material had long been debated. Trevithick and Robert Stevenson had taken ground in favor of iron vessels and iron spars. Dickenson patented an iron boat in 1815, and a few years later enterprising builders launched a couple of iron craft. John Laird, of Birkenhead, built a number of iron vessels, the paddle steamer John Randolph finding a purchaser in G. B. Lamar, of Savannah. The Rainbow, of 600 tons, was much the largest iron steamer in existence prior to the advent of the Great Britain. Brunel firmly believed in the principle of screw propulsion, which, although Ericsson had shown its feasibleness, was generally regarded as impracticable. Ericsson's departure for America, under the patronage of Commodore Stockton, enlarged the scope of Thomas Pettit Smith, whose company put the screw-propeller to a practical test in 1839, the Archimedes being the fitting name of the craft on which the experiment was tried. Although it was intended to use paddle wheels on the Great Britain, Brunel prevailed on the directors to substitute the screw-propeller. The Great Britain is described as follows: Total length, 322 feet; length of keel, 289 feet, beam, 51 feet; depth, 32 feet 6 inches; draught of water, 16 feet; tonnage measurement, 3,443; displacement, 2,984 tons; number of cylinders, 4; diameter of cylinders, 88 inches; length of stroke, 6 feet; weight of engines, 340 tons; weight of boilers, 200 tons; weight of water in boilers, 200 tons; weight of screw shaft, 38 tons; diameter of screw, 15 feet 6 inches; pitch of screw, 25 feet; weight of screw, 4 tons; diameter of main drum, 18 feet; diameter of screw-shaft drum, 6 feet; weight of coal, 1,200 tons. "The main shaft of the engine," says the Life of Brunel, "had a crank at either end of it, and was made hollow, a stream of water being kept running through it, so as to prevent heating in the bearings. An important part of the design was the method by which motion was transmitted from the engine shaft to the screw shaft, for the screw was arranged to go three revolutions to each revolution of the engines. Where the engines do not drive the screw directly, this is now universally effected by means of toothed gearing; but when the engines of the Great Britain were made it was thought that this arrangement would be too jarring and noisy. After much consideration, chains were used working around different-sized drums, with notches in them, into which fitted projections on the chains." After plying a short time between Liverpool and New York, the Great Britain was sold for use in the Australian trade. Still later she was changed into a sailing vessel, and in 1886 received serious injuries from stranding at the Falkland Islands. The Great Western company had been ruined mainly by the competition of the steadily rising Cunard Line, which in 1840 had launched the mail steamers Acadia, Britannia, Columbia, and Caledonia. All these ships were of wood, and employed the old-fashioned paddle wheels. Originally entered into for seven years, the mail contract with the British government lasted for forty-six years. The Britannia left Liverpool, Friday, July 4th, 1840, and made Boston 14 days and 8 hours later. Her dimensions, substantially the same as her sisters, were as follows: Length of keel and fore rake, 207 feet; breadth of beam, 34 feet 2 inches; depth of hold, 52 feet 4 inches; mean draught, 16 feet 10 inches; displacement, 2,050 tons; diameter of cylinder, 72½ inches; length of stroke, 82 inches; number of boilers, 4; pressure carried, 9 pounds per square inch; number of furnaces, 12; fire-grate area, 222 feet; indicated horse-power, 740; coal consumption per indicated horse-power per hour, 5.1 pounds; coal consumption per day, 38 tons; bunker capacity, 640 tons; cargo capacity, 225 tons; cabin passengers carried, 90; average speed, 8.5. In 1843 the Hibernia and in 1845 the Cambria joined the four vessels above named. Only first-class passengers were carried in those days, the steamship emigrant business dating from 1850, while no Cunarder was prepared for emigrants until 1853. Since that time the magnitude of the emigrant traffic has become one of the wonders of the world.

AMERICAN PROGRESS IN THE CONSTRUCTION OF STEAMSHIPS.

On the western side of the Atlantic the steamship had a steady growth. By 1832 our shipwrights were building side-wheelers for coasting service. The New York coasters were so strong and rapid as to secure the yards of that city a number of orders for steam frigates from foreign nations. The New Orleans packet, United States tonnage 1,857, was an excellent vessel, carrying heavy burdens on light draught.

In 1847 the United States government determined to use steam for carrying the mails. This year saw the rise of the United States Mail and Pacific Mail companies. During 1847–48 the Pacific Mail set afloat the California, 1,058 tons; the Panama, 1,087 tons; and the Oregon, 1,099 tons. The United States Mail built the Georgia, 2,727 tons; the Illinois, 2,123 tons, and the Ohio, 2,432 tons. Wood and paddle-wheels were still deemed sufficient.

Almost magical results followed when gold was discovered in California. Within ten years twenty-nine steamers were added to the two lines named above. It is reckoned that during that eventful decade they carried 175,000 persons to California, bringing back gold to the amount of $200,000,000. Tonnage had to be increased, and in 1864 the Golden City, of 3,373 tons, was built. From 1830 to 1861 the four leading seaboard cities constructed, on home and foreign orders, about eighty sea-going steamers, with an aggregate tonnage of 120,000, and a total cost of about $29,000,000.

The Clarion, of 250 tons, built in 1841 to run between New York and Havana, was fitted up with a screw-propeller. The next year six screw-steamers were built at Philadelphia. As years passed the screw more than doubled its diameter, and the once universal paddle-wheel fell into decay and disuse for vessels intended to navigate the ocean. Woodcroft, Loper, and others made alterations and improvements on the screw system. Hall believes the Massachusetts, of 751 tons, to have been the first large ocean steamer sent out from an American port.

In 1845 the post office contracted with Edward Mills for twenty trips a year to Europe, it being deemed advisable to follow the example of the British government in assisting steamship lines. The original grant to the Cunard company of £80,000, was subsequently increased to £145,000, and still later to £173,000 per annum. Our trans-Atlantic business was suffering severely from British competition. Four hundred thousand dollars per year was granted to Mr. Mills, who secured the construction of two steamers, the Washington and the Hermann, at New York, Westervelt & Mackay being the builders. The steamers were to sail for Bremen monthly in winter and semi-monthly in summer. In appearance Mills' ships resembled long sailing packets, painted black and white, and fitted up with paddle-wheels. In seaworthiness and general utility these steamships acquitted themselves well, but in speed they were decidedly inferior to the Cunarders. In 1850 the Franklin and Humboldt were built for the Bremen line, but their destination proved to be the Havre trade.

William Wheelright, an American, finding his own country slow to respond to his project, went to England and took an active part in early operations of the Pacific Steam Navigation Company, a corporation which ultimately expanded to large proportions.

In 1843 the frigate Missouri, while lying at Gibraltar, was destroyed by fire; but this ill-wind blew good to the cause of steamship building. Congress subsequently pledged itself to pay $385,000 per annum to Edward K. Collins, conditional on his building and operating, for twenty trips per year between New York and Liverpool, four steamers of two thousand tons, that might be used as men-of-war in case of hostilities with a foreign power. Mr. Collins did more than was required of him. William H. Brown, of New York, under George Steers' direction, built the Arctic, of 2,856 tons, and the Atlantic, of 2,845 tons. Brown & Bell, of New York, built the Baltic, of 2,723 tons, and the Pacific, of 2,707 tons. These gigantic four-deckers won and merited general admiration. Their average time from New York to Liverpool was 10 days, 21 hours, and from Liverpool to New York 11 days, 3 hours. The average time of the Cunarders was from New York to Liverpool 11 days, 12 hours, and from Liverpool to New York 12 days, 9 hours. From January to November, 1852, the Collins Line carried 4,306 passengers, against the Cunard's 2,969. Freight rates were soon cut down to one-half. Recognizing at once a powerful rival the Cunard Line began to build new and superior ships. Our Government increased Collins' subsidy to $858,000 per annum, on condition that he should increase his speed. The Collins company handsomely sustained its head. In 1854 a collision with the Vesta destroyed the Arctic, but the next year saw her replaced by the Adriatic, of 4,144 tons. This giantess showed, in 1861, how well she deserved the $1,100,000 spent on her, by running from St. John's to Galway in 5 days, 19¾ hours.

New British lines were springing up meanwhile, and side by side with their growth grew and spread a feeling of hostility to the Collins Line subsidies. In 1856 they were cut down to $385,000, and the loss of the Pacific, with her crew and cargo, in the same year, verified the homely adage that misfortunes never come singly. In 1857 both the Collins and Mills contracts expired, and the Government refused to renew them. As receipts were not equal to expenses, both lines were obliged to sell their ships, and much of our commerce fell into foreign hands. During and since the civil war the steamships of Great Britain have been steadily gaining prominence as oceanic carriers of American commerce. A Boston company in 1866 made a spirited but fruitless attempt to struggle with the British, and a Baltimore venture met with no better fate. Southern coasters have, however, to a greater or less extent, participated in the Mexican and West Indian trade, and Garrison, Roach, and others have sought to build up commerce with Brazil.

THE AMERICAN LINE.

A promising and vigorous effort to establish an American line was made in Philadelphia during the eighth decade. It was backed principally by an endorsement of its bonds by the Pennsylvania Railroad Company. Hall, in census report on American ship-building industries in 1880, printed in 1884, says that "in 1872 Mr. Cramp, of Philadelphia, obtained the contract to build four steamers, respectively named Pennsylvania, Ohio, Indiana, and Illinois, for the new American Line to Liverpool, of 3,016 tons each, at a total cost of $2,400,000. These boats made the reputation of the yard, and there being then no American steamers in the trade from the United States to Europe (and indeed there have been none since), it was deemed important to construct them in good style as specimens of American workmanship.

They were modeled long and narrow, with fine bows and runs and slightly hollow water lines. The dimensions of each were: Length over all, 355 feet; breadth of beam, 43 feet; depth of hold, 35 feet. Decks, 3 in number; 2 masts. Each ship was supplied with two compound 1,800-horse-power engines, with 57- and 90-inch cylinders, having 4-feet stroke, a 16-foot wheel. The ships were completed in 1873, and proved fast, smart, and strong vessels; their speed was 13 miles an hour. They have now been running nine years, and are insured by English companies at the most favorable rates given to any iron vessels afloat. As passenger boats they fully answered all expectations; their average time from Cape Henlopen to Queenstown is 9½ days, and on the return 10 days, 2 hours. Each carries 100 cabin and 800 steerage passengers, 1,740 tons of cargo, and 720 tons of coal on 20½ feet draught of water. The export trade to Europe now requires steamers which can carry 3,000 tons of cargo, but in the day when they were built the American boats did all that was demanded of them."

Notwithstanding the excellence of the vessels and the strong support they received, they were generally run at a loss for some years, chiefly for reasons similar to those which led to the failure of other American steamships to compete with European lines, one of the most important of which is that the latter receive governmental subsidies while the former do not. This line was subsequently practically absorbed in the extensive system controlled by the International Navigation Company, to which more particular reference is made elsewhere, and early in 1887 it was stated that "of the four vessels of the American Line, the Ohio is now undergoing important changes. New engines that will secure a speed of fourteen knots an hour are being placed in her, and she will have first-class saloon passenger accommodations on deck, after the plan of the Westernland and Noordland. The same changes will be made in the Pennsylvania, Indiana, and Illinois, and this fleet of American-built vessels will afford the very best facilities for the use of trans-Atlantic travelers."

The period since the war has witnessed many changes. Cramp, Roach, Harlan & Hollingsworth, and Pusey & Jones have done excellent work. In various parts of the country new vessels of all sizes have been constructed. Hall says: "On the whole, it can be reported that the building of iron and steel vessels has made sufficient progress in the United States to have created the plant and trained the labor for producing sailing and steam craft for the merchant service of every description and of any size. . . . The merchant service is well provided for, and the industry is growing, in spite of the high cost of American labor and materials. New yards are continually coming into existence. The general development of American industry is reducing the cost of materials, and the use of machinery is reducing the expenditures for labor upon vessels. The competition in rival yards is lessening the margin of profit for which their proprietors are willing to build, and the tendency is all in the direction of favoring the substitution of iron or steel tonnage in place of wooden. There are other industries which effect changes for the benefit of this generation for which future generations will have to pay. Iron ship-building appears to inflict no injury as far as consumption of materials is concerned, and it is a department of activity which employs a greater proportion of human labor to the value of material used than almost any other which can be named."

STEAMSHIP SERVICE IN 1865.

Of the foreign steam-carrying trade, shortly after the close of the civil war, the New York Tribune, of August 1st, 1865, said: "The total carrying trade performed by steam vessels between this country and Europe is now in the hands of eight regular lines, running about fifty vessels, not one of which carries the American flag. The old Cunard Line, most prudently and hence successfully managed from the start, has seen the wreck of its rival, the Collins, and has steadily increased in business until it runs regularly six vessels, though owning eight or ten. The Inman, a young line, started with the main interest of furnishing to the better class of emigrants accommodations superior to those of sailing vessels, has built boat after boat, until it now has thirteen completed, and dispatches two per week from this port to Queenstown and Liverpool. The National—another British company—has eight vessels, and from an irregular line is now dispatching a regular vessel weekly. Then there is the French line to Havre, at present a monthly line, but pushing new vessels to completion with all dispatch; the Glasgow Line, devoted largely to the carrying of immigrants; the Quebec and Portland Line; and the two German lines, one to Hamburg and one to Bremen, both running semi-monthly vessels. While of the seven splendid American ships which formerly crossed the ocean, the Arctic and Pacific are beneath it; the Adriatic passed into foreign hands; the Baltic, Atlantic, Arago, and Fulton have been in transportation service during the war.

A notable fact, suggested by looking over the lines now in operation, is the remarkable increase in screw vessels. Excepting the French line to Havre, and the older of the Cunard vessels, not more than three of the whole fifty steamers now crossing the Atlantic are driven by side-wheels, and nearly every one now constructed for trans-Atlantic service adopts the screw."

RELATIVE GROWTH OF STEAM TONNAGE IN THE UNITED STATES AND GREAT BRITAIN.

A report presented by the Secretary of the Treasury to the Senate in 1864 gives the tonnage of the United States employed in steam navigation from 1823 to 1863, inclusive. Contrary to what might have been expected, the list shows marked fluctuations instead of an unbroken advance. In 1815 the tonnage was 28,879, the next two years showing 21,609 and 23,061, respectively, followed by two decided gains of 34,058 and 40,197. In 1828 it fell to 39,418, bounding up to 54,036 in 1829, and 64,471 in 1830. In 1831 it fell to 34,135, but in 1839 it had reached 204,938, falling off slightly in 1840, and heavily in 1841, but footing up 229,661 in 1842. An unbroken and rapid rise now began, culminating in 1852, when tonnage aggregated 643,240. Despite two or three heavy declines in unfavorable years, the tendency remained upward for nearly a decade, the tonnage of 1861 being 877,203. In 1862 it fell to 710,462, and in 1863 to 575,518.

Up to 1864 the steamship exerted comparatively little influence on our foreign trade, but about that time it was pressed into service in our commerce with France, England, Germany, the West Indies, and the Pacific. In the Treasury report before mentioned steamers in the isthmus and California trade are not classified with those engaged in foreign commerce. The aggregate of steam tonnage entering our ocean ports during the fiscal year ending June 30th, 1848, was 54,891, of which 13,534 was American. Marked fluctuations occurred, but the general tendency was toward an advance, and in the fiscal year ending June 30th, 1860, the tonnage amounted to 775,915, of which 384,899 was American. The figures for the three following fiscal years were: 1861, total, 753,848; American, 313,903; 1862, total, 637,259; American, 212,675; 1863, total, 724,932; American, 247,009. The actual steam tonnage arriving in foreign trade was much less than statistics would indicate, the returns for four fiscal years being: 1860, total, 456,449; American, 68,564; 1861, total, 508,346; American, 68,880; 1862, total, 440,463; American, 15,884; 1863, 473,114, all of which was foreign.

The following comparative table shows the steam tonnage of the United States and of the British Empire, beginning with the year in which ocean steam navigation may be said to have been put fairly on its feet. American tonnage is divided into "oversea," or that which can trade beyond United States waters, and "enrolled," which includes all in home waters:—

	United States. Oversea.	United States. Enrolled.	Total.	British Empire (including colonies.)
1838	2,791	190,632	193,423	82,716
1840	4,155	198,184	202,339	95,807
1842	4,701	224,960	229,681	118,930
1844	6,909	265,270	272,179	125,675
1846	6 287	341,606	347,893	144,784
1848	16,068	411,823	427,891	168,078
1850	44,942	481,005	525,947	187,631
1852	79,704	563,536	643,240	227,306
1854	95,036	581,571	676,607	326,484
1855	115,045	......	......	......
1856	89,715	583,362	673,077	417,717
1858	78,027	651,363	729,390	488,415
1860	97,296	770,641	867,937	500,144

Since 1860 the relative position has greatly changed, the steam tonnage of Great Britain being increased with extraordinary rapidity, until it represents a very large proportion of the oceanic steam tonnage of the world.

The amount of steam tonnage built in the United States and in Great Britain at intervals of five years from 1855 is as follows:—

UNITED STATES.

	Number.	Tonnage.	Average tonnage.
1855	246	72,760	296
1860	265	69,370	259
1865	411	146,433	356
1870	290	70,621	244
1875	323	62,460	193
1880	348	78,853	229
1885	338	84,333	249

UNITED KINGDOM.

	Number.	Tonnage.	Average tonnage.
1855	278	106,872	385
1860	234	67,699	289
1865	453	211,665	467
1870	512	267,896	523
1875	428	226,701	530
1880	629	414,831	660
1885	487	221,918	456

Commander Chadwick considers at some length the causes of our failure to hold our own in the struggle for the world's carrying trade, blaming the Collins Line for "extravagance in construction and management." He accounts for our great increase in enrolled tonnage by the fact that the Union was not then covered by a network of railways, and for our subsequent failure to hold our proud position, by our conservatism. Americans closed their eyes to what Englishmen, Germans, and Frenchmen regarded as a truism—the superiority of iron to wood, and of the screw to the paddle. Even after the civil war had proved our national capacity to construct great iron-clads, the Pacific Mail sent out four great wooden steamers. In part it may be urged, in answer to this, that in England iron was cheap and wood dear, while in the United States wood was cheap and iron was dear. Wooden ships, also, if provided with screws, need more frequent repair than if built in accordance with the old paddle system. Our navigation laws are, in Commander Chadwick's opinion, extremely faulty. "But the great cause, and overwhelming cause," he says, "was the opening up of the vast region lying west of the earlier-formed states; the building of our gigantic system of railway; the exploitation, in a word, of the great inter-domain of the possibilities of which preceding 1850 we were only dimly conscious, and so much of which had only just been added by the results of the Mexican war."

MECHANICAL ADVANCES AND INCREASE OF EFFICIENCY.

In the progress of steamship development many mechanical improvements have been made, the most important of which relate to an increase of size and speed, changes in external form and internal arrangements, and radical modifications in the construction of engines. Through these changes a great reduction has been effected in the quantity of coal required to secure a given amount of efficiency. The advances in the latter direction have been very remarkable, and it is through them mainly that the principal original objections to steam vessels have been overcome by the reduction of expenses for fuel, and of amount of dead weight to be carried on long voyages. In 1881 it was stated that the expenditure of fuel had been lowered 13.37 per cent. since 1872. Of one of the comparatively recent steamships it is said that the amount of force necessary to move a ton one mile could be furnished by the heating power derived from the burning of a sheet of paper. The decrease in expenditure of coal per hour per horse-power of engines, from 1830 to 1886, is estimated as follows: 1830, 9 pounds; 1840, 5½ pounds; 1850, 4 pounds; 1860, 3.1 pounds; 1870, 2.6 pounds; 1880, 2.2 pounds; 1886, 1.5 pounds.

While a great reduction in the actual cost of moving freight across the sea was effected through an increase in the size of steamships, and a decrease in the amount of coal consumed per horse-power of engines, there was also a marked increase in speed, or decrease in time required to cross the Atlantic. The best steamship records of 1886–87 show a reduction in time of more than one-half since 1840, and of 40 per cent. since 1860. On June 4th, 1887, another lowering of records occurred, of which the New York Times, of June 5th, 1887, said:—

"The record of the 'ocean greyhounds' has again been lowered. The vessel which now stands at the head of the list is the Umbria, of the Cunard Line, which arrived yesterday from Liverpool and Queenstown. Her time from the latter port was 6 days, 4 hours, and 12 minutes. The Etruria, of the same line, which has heretofore stood at the head of the list, but which now takes second place, has made the westward passage in 6 days, 5 hours, and 36 minutes, and the eastward passage in 6 days, 5 hours, and 18 minutes, or over an hour behind the Umbria's last performance.

The total distance traveled after leaving Queenstown was 2,848 miles. The average speed maintained was nearly 19¼ miles an hour. The highest day's run during the voyage was 481 miles, which was completed at noon yesterday. The Umbria beat this admirable day's work in a former voyage, when she ran 496 miles in a single day."

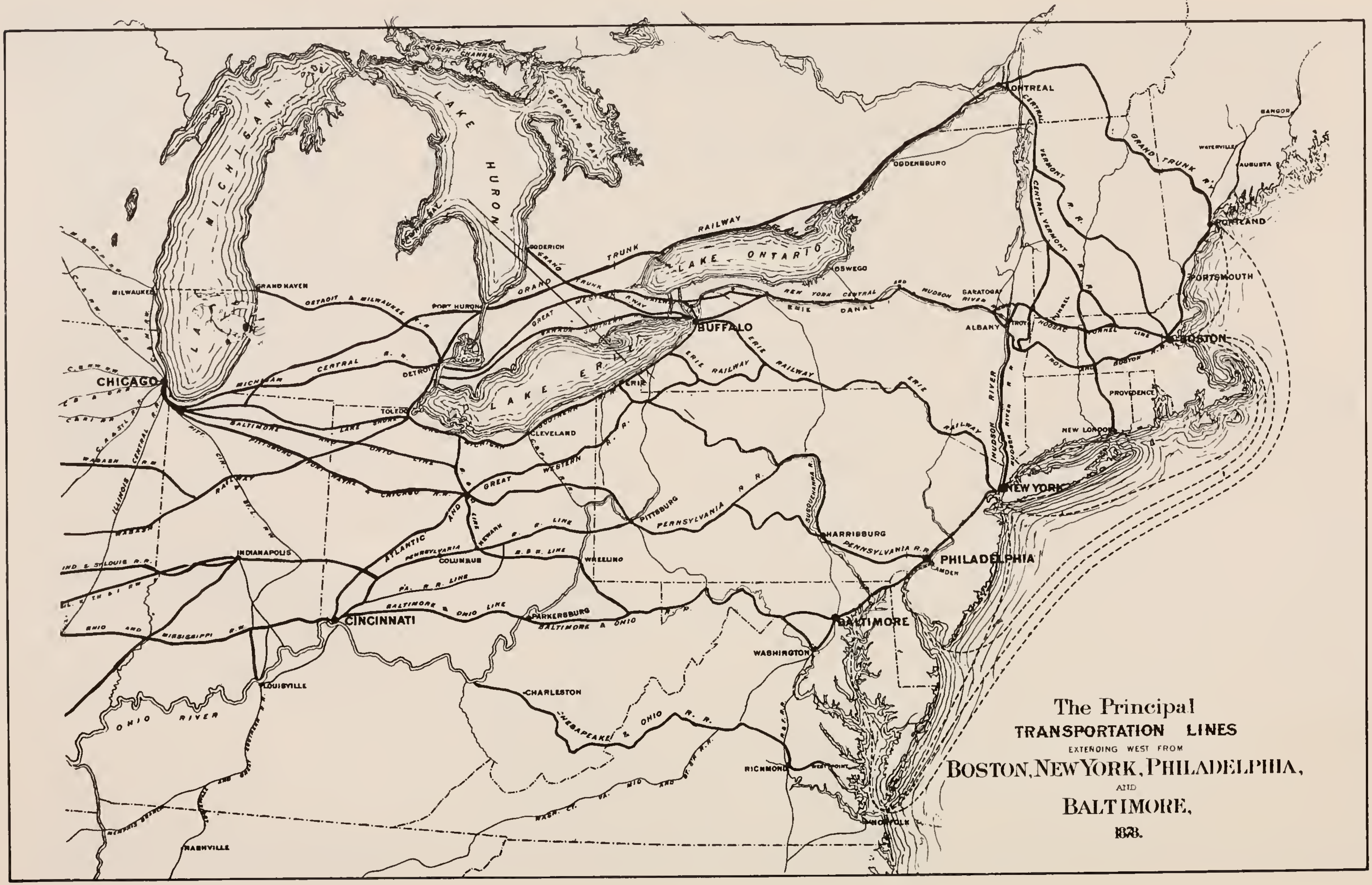
THE CONCENTRATION OF STEAM POWER

used on the gigantic steamships, especially those which desire to attain great speed, represents one of the greatest marvels of modern industrial development, when viewed in connection with the wonderful extent to which fuel is economized. Steamships propelled by engines which indicate about 4,000 horse-power are not uncommon, and the nature of the requirements in cases where a combination of great size with a high rate of speed are desired, is furnished by the statement that "to appreciate what is required to make 19 knots an hour at sea we have only to remember that the Umbria and Etruria are 500 feet long, with more than 12,000 tons displacement and 14,500 indicated horse-power, ordinarily making 18½ knots an hour, and on special occasions 19 knots. Now, to increase her speed to 20 knots an hour the Umbria would require about 19,500 horse-power, which means 5,090 extra horse-power for the extra knot. For a second extra knot would be required about 6,000 horse-power more, making about 25,000 horse-power necessary to develop a speed of 21 knots."

THE SIZE OF OCEAN STEAMSHIPS.

The following table gives the name, date of construction, tonnage, length, breadth, and depth of the principal steamships plying, in the latter part of 1888, between European and American shores:—

Name.	Built.	Gross tonnage.	Length.	Beam.	Depth.
City of New York	1888	10,500	525	63.3	42
City of Paris	1888	10,500	525	63.3	42
City of Rome	1881	8,144	546	52	37
Umbria	1884	7,800	500	57.2	38.1
Etruria	1884	7,718	501.6	57.2	38
Servia	1881	7,392	515	51.1	37
Aurania	1882	7,269	470	57.2	37.2
Le Bretagne	1886	7,012	508.4	52.4	38.4
La Bourgogne	1886	7,000	508.6	52.2	38.8
La Champagne	1886	7,005	508.7	51.6	38.4
La Gascogne	1886	7,008	508.7	52.2	38.3
Alaska	1881	6,932	500	50.6	38
Friesland	1888	6,700	425	51	39
America	1883	6,500	432	51.3	35.8
Normandie	1882	6,062	459	50	37
Westernland	1883	5,736	455	47	35
Saale	1886	5,500	455	48	38
Trave	1886	5,500	455	48	38
Aller	1886	5,500	455	48	38
City of Berlin	1874	5,491	488.6	44.2	34.9
Noordland	1883	5,212	400.7	47	35.3
City of Chicago	1883	5,202	430	45	33.6
Eider	1883	5,200	450	47	33.6
Arizona	1879	5,147	464	46	37
Ems	1884	5,129	430.5	47	34.5
Fulda	1883	5,109	450	46	36
Werra	1882	5,109	450	46	36
Belgravia	1881	5,080	398.2	44.5	32.2
Germanic	1874	5,008	455	45.2	33 7
Britannic	1874	5,004	455	45.2	33.7
Elbe	1881	4,911	420	45	36.5
England	1865	4,898	437	42.5	35
Egyptian Monarch	1880	4,709	370	44	35.8


The Principal
TRANSPORTATION LINES
EXTENDING WEST FROM
BOSTON, NEW YORK, PHILADELPHIA,
AND
BALTIMORE,
1878.
CHICAGO
MILWAUKEE
GRAND HAVEN
LAKE MICHIGAN
LAKE HURON
GEORGIAN BAY
NORTH CHANNEL
GODERICH
PORT HURON
DETROIT
TOLEDO
CLEVELAND
ERIE
LAKE ERIE
BUFFALO
LAKE ONTARIO
OSWEGO
OGDENSBURG
MONTREAL
PORTLAND
AUGUSTA
WATERVILLE
BANGOR
PORTSMOUTH
BOSTON
PROVIDENCE
NEW LONDON
ALBANY
TROY
SARATOGA
NEW YORK
PHILADELPHIA
CAMDEN
HARRISBURG
PITTSBURG
WHEELING
COLUMBUS
NEWARK
PARKERSBURG
BALTIMORE
WASHINGTON
RICHMOND
NORFOLK
CHARLESTON
CINCINNATI
INDIANAPOLIS
LOUISVILLE
NASHVILLE
OHIO RIVER
HUDSON RIVER
SUSQUEHANNA R.
GRAND TRUNK RAILWAY
GRAND TRUNK R.
CENTRAL VERMONT R. R.
VERMONT CENTRAL
HOOSAC TUNNEL LINE
BOSTON R. R.
HUDSON RIVER R. R.
NEW YORK CENTRAL AND HUDSON RIVER
ERIE CANAL
ERIE RAILWAY
GREAT WESTERN R.WAY
CANADA SOUTHERN
DETROIT & MILWAUKEE R. R.
MICHIGAN CENTRAL R. R.
LAKE SHORE
BALTIMORE & OHIO LINE
PENNSYLVANIA R. R.
PA. R. R. LINE
ATLANTIC AND GREAT WESTERN R. R.
PITTSBURG FORT WAYNE & CHICAGO R.R.
CHESAPEAKE & OHIO R. R.
OHIO AND MISSISSIPPI R.W.
ILLINOIS CENTRAL R.R.
WABASH
IND. & ST. LOUIS R.R.

Name.	Built.	Gross tonnage.	Length.	Beam.	Depth.
City of Richmond	1873	4,607	452.6	43	36
Erin	1864	4,500	415	41	35
City of Chester	1873	4,565	475	44.3	35
Spain	1871	4,512	425.4	43.2	36.2
The Queen	1865	4,457	380.1	42.4	37.3
Grecian Monarch	1882	4,364	381	43	33
Greece	1863	4,310	390.7	41.3	35.3
Devonia	1877	4,269	400	42	32
Hammonia	1882	4,247	375	45	34
Italy	1870	4,169	389	42 3	38.7
Anchoria	1874	4,168	480	40.1	33.8
State of Nebraska	1880	4,000	385	43	34
Ethiopia	1873	4,005	402	40.2	33
Lydian Monarch	1881	3,916	360	43	32.4
Adriatic	1871	3,888	437.2	40.9	31
Celtic	1872	3,867	437.2	40.9	31
Denmark	1865	3,724	342.9	42.2	36
Republic	1871	3,707	420	40.9	31
Baltic	1871	3,707	420	40 9	31
Suabia	1874	3,704	360	41	34
Wisconsin	1870	3,700	378	43.2	32

ESTABLISHMENT OF NEW LINES—THE INTERNATIONAL NAVIGATION COMPANY.

The Inman Line was established in 1850; the North German Lloyd and the Compagnie Transatlantique in 1858; in 1863 the National; in 1866 the Williams & Guion (now the Guion), and in 1870 the White Star.

The International Navigation Company claims mention in any, even the briefest, allusion to the work that has been done in providing swift and convenient trans-oceanic passage. It now controls the Red Star and Inman lines, and the four American Line steamers, Pennsylvania, Ohio, Illinois, and Indiana.

It has introduced into the Inman Line, since it purchased this company's property, the steamships "City of New York" and "City of Paris," which are the largest and swiftest passenger steamships afloat. They are specially constructed, and so subdivided by bulkheads as to be unsinkable, and are fitted with twin engines and twin screws, thus rendering a disablement at sea practically impossible. These steamers were fully described in the London Times, of December 21st, 1887. That description, in referring to their unique provisions for safety, says: "Many ships have been divided by bulkheads in such a way that if one compartment were flooded the ship would be perfectly seaworthy, but in the case of an accident where the ship was struck on the bulkhead and the two compartments adjacent flooded, she would inevitably sink. In the case of these new Inman boats, however, the subdivision is such that the ship would remain perfectly seaworthy, with any two, or even three, compartments flooded." The article proceeds to point out additional novel elements of safety arising from special precautions against fire, complete boat accommodations for every soul on board, and devices for quickly lowering every boat if a necessity for removing passengers should arise. To guard against delays and dangers caused by derangements of machinery, two sets of engines, each set driving a separate screw, were provided. Of this important and novel provision the Times says: "The engines are in two separate compartments, subdivided by a water-tight bulkhead, and the boilers are in three separate compartments, completely cut off from each other, so that these vessels might be in collision by being struck on any bulkhead, and could have a breakdown in their machinery, such as may occur in any ordinary ship, and still be quite navigable and thoroughly safe and seaworthy. While, therefore, the vessels are well provided against the effects of collision, they are also very much better able to avoid collision by having two sets of machinery, one of which could be readily reversed while the other was going ahead, thus turning the vessel."

In addition to the four American Line steamers the following Red Star steamers are now (1888) running from New York and Philadelphia to Antwerp: Friesland, 6,700 tons; Westernland, 6,000 tons; Noordland, 5,500 tons; Waesland, 5,000 tons; Belgenland, 4,000 tons; Rhynland, 4,000 tons; Pennland, 4,000 tons; Switzerland, 3,000 tons; Nederland, 3,000 tons; Vaderland, 3,000 tons; Zeeland, 3,000 tons.

The Inman Line steamers now running from New York, Queenstown, and Liverpool are as follows: City of New York, 10,500 tons; City of Paris, 10,500 tons; City of Chicago, 5,202 tons; City of Berlin, 5,491 tons; City of Richmond, 4,780 tons; City of Chester, 4,770 tons; City of Montreal, 4,500 tons.

EFFECT OF STEAMSHIP PROGRESS IN INCREASING FOREIGN COMMERCE.

Figures from Government reports adduce their unanswerable logic to show how steam developed foreign commerce. The total imports of the United States in 1821 reached $62,585,724, the exports for the same period being valued at only $43,671,894. Not until 1831 did the imports and not until 1835 did the exports pass the one hundred million mark. In 1848 our imports were valued at $154,998,928, and our domestic exports at $132,904,121. In 1857 the imports were $360,890,141, and the domestic exports, $338,985,065. From 1857 to 1886, inclusive, the course of foreign trade, exclusive of the movement of specie, is shown by the following table:—

Value of merchandise imported into, and exported from, the United States, from 1858 to 1886, inclusive.

Year ending Sept 30 –	Exports— Domestic.	Foreign.	Total exports.	Imports.	Total exports and imports.
1858..	$251,351,033	$20,660,241	$272,011,274	$263,338,654	$535,349,928
1859..	278,392,080	14,509,971	292,902,051	331,333,341	624,235,392
1860..	316,242,423	17,333,634	333,576,057	353,616,119	687,192,176
1861..	204,899,616	14,654,217	219,553,833	289,310,542	508,864,375
1862..	179,644,024	11,025,477	190,670,501	189,356,667	380,027,178
1863..	186,003,912	17,960,535	203,964,447	243,335,815	447,300,262
1864..	143,504,027	15,333,961	158,837,988	316,447,283	475,285,271
1865..	136,940,248	29,089,055	166,029,303	238,745,580	404,774,833
1866..	337,518,102	11,341,420	348,859,522	434,812,066	783,671,588
1867..	279,786,809	14,719,332	294,506,141	395,761,096	690,267,237
1868..	269,389,900	12,562,999	281,952,899	357,436,440	639,389,339
1869..	275,166,697	10,951,000	186,117,697	417,506,379	703,624,076
1870..	376,616,473	16,155,295	392,772,768	435,958,408	828,730,176
1871..	428,398,908	14,421,270	442,820,178	520,223,684	963,043,862
1872..	428,487,131	15,690,455	444,177,586	626,595,077	1,070,772 663
1873..	505,033,439	17,446,483	522,479,922	642,136,210	1,164,616,132
1874..	569,433,421	16,849,619	586,283,040	567,406,342	1,153,689,382
1875..	499,284,100	14,158,611	513,442,711	533,005,436	1,046,448,147
1876..	525,582,247	14,802,424	540,384,671	460,741,190	1,001,125,861
1877..	589,670,224	12,804,996	602,475,220	451,323,126	1,053,798,346
1878..	680,709,268	14,156,498	694,865,766	437,051,532	1,131,917,298
1879..	698,340,790	12,098,651	710,439,441	445,777,775	1,156,217,216
1880..	823,946,353	11,692,305	835,638,658	667,954,746	1,503,593,404
1881..	883,925,947	18,451,399	902,377,346	642,664,628	1,545,041,974
1882..	733,239,732	17,302,525	750,542,257	724,939,574	1,475,181,831
1883..	804,223,632	19,615,770	823,839,402	723,180,914	1,547,020,316
1884..	724,964,852	15,548,757	740,513,609	667,697,693	1,408,211,302
1885..	726,682,946	15,506,809	742,189,755	577,527,329	1,319,717,084
1886..	665,964,529	13,560,301	679,524,839	635,436,136	1,314,969,966

RELATION BETWEEN STEAMSHIP LINES AND RAILWAY LINES.

The principal basis of the great increase of the foreigu commerce of the United States is furnished by the exports of comparatively crude domestic articles, consisting chiefly of agricultural products. A leading business of the railway companies, in turn, is to convey such products from districts in which they are produced to seaboard cities, where they can either be consumed, distributed to domestic centres of consumption, or exported. The percentage of the leading articles forwarded to seaboard cities that is exported varies considerably with fluctuations in foreign demand, state of the crops, and other causes, but it not unfrequently happens that the percentage of exports is very large, and it is always increased materially by the facilities furnished by steamships for cheap and rapid oceanic transportation. Out of this condition of affairs has grown at various times and places alliances, more or less complete, which sometimes consist of direct business connections and at other times of traffic contracts, between railway and steamship lines, and also the custom of frequently issuing through bills of lading, which represent contracts for the entire movement between Chicago or other interior traffic centres and Liverpool or other foreign ports. There are also close alliances between some of the coastwise steamship lines and railway companies.

Some of the most serious of the modern strifes between rival seaboard cities and rival trunk lines have arisen out of disputes which hinged on the relative advantages of Boston, New York, Philadelphia, and Baltimore as ports through which the joint rail and steamship movement between interior agricultural or traffic centres and Liverpool or other foreign centres of consumption could be made. The complexity of the problems involved was increased by the respective variations in overland distance between the ports and the most important interior traffic centres on the one hand and an analogous oceanic difference between such ports and leading foreign ports on the other. New York, for instance, is further from Chicago than Philadelphia or Baltimore, but nearer to Liverpool. As a large proportion of the breadstuffs, provisions, tobacco, and other articles shipped from the interior to the North Atlantic seaboard cities is usually exported, the question became one of great commercial interest through which of these cities the foreign export movement could be most cheaply and conveniently made, strong influences in each city being actively exerted against any adjustment of rail rates that would give an advantage to either of its rival cities. Railway managers endeavored to adjust the controversy on the principle of equality or impartiality, so that the export movements could be made through either city on substantially the same terms that could be obtained in any other city. There is always an approximation to an enforcement of this theory, intermingled with deviations of varying magnitude, which arise chiefly through fluctuations in oceanic steamship rates. In an elaborate report on this subject, made by Albert Fink in 1882, he stated that the only practical plan for enforcing the principle of equality, so far as it related to grain exports, was "to agree upon fixed inland rates upon the whole grain traffic, domestic and export, and to determine the through rates by adding the ocean rates, whatever they may be, from time to time, from the different cities to points of destination, and that the adjustment of the inland rates to the seaboard must be made more with the view to the export trade than to domestic traffic." Controversies of a later date indicate that methods which substantially conform to this recommendation have frequently been adopted.

OCEAN STEAMSHIP RATES.

In the years named below the average annual steamship charges per 100 pounds for movements to Liverpool were as follows:—

Year	From New York. Cents.	From Philadelphia. Cents.	From Baltimore. Cents.	From Boston. Cents.
1877	22 9	26 9	27.5	....
1878	25.1	28.2	28.8	23.8
1879	20.6	24 2	23 0	20.0
1880	19.7	21.4	22 3	19.0

In each of the years there was a considerable fluctuation in the oceanic rates, so that the charges were higher in some months than in others. There have also been occasional competitive strifes between rival steamship lines analogous to those which have occurred between rival railway lines, and some of these struggles presumably represent combinations of one set of railway and steamship lines, against corresponding antagonistic combinations. Through these strifes excessively cheap oceanic and land service has been obtained, such as a reduction of the joint rates for a through movement between Chicago and Liverpool to a lower point than that represented by the figures given above for an oceanic movement between north Atlantic seaboard cities and Liverpool; and even when oceanic and rail rates are fully maintained the entire cost of moving domestic merchandise between interior ports and European seaboard cities represents only a small fraction of the charges which were formerly imposed for such service.

STEAMSHIPS IN COASTING TRADE, &C., AND STEAMBOATS.

A NUMBER of steamships built in the United States are used in the coasting trade either on the waters of the Atlantic and gulf of Mexico or on the Pacific coast or in foreign trade with the West Indies or South American or Asiatic ports. The official list of merchant vessels for the year ended June 30th, 1884, embraced an enumeration of 6,111 steam vessels of all kinds, of which the following were classed as steamships, having a gross tonnage of more than 2,000 tons:—

Name of vessel.	Gross tonnage.	When built.	Where built.	Home port.
Acapulco	2,572.38	1873	Wilmington, Del.	New York.
Advance	2,604.57	1883	Chester, Pa.	New York.
Alamedo	3,158 23	1883	Philadelphia.	San Francisco.
Alamo	2,942.85	1883	Chester, Pa.	New York.
Algiers	2,287.34	1876	Wilmington, Del.	New Orleans.
Allegheny	2,014.42	1881	Philadelphia.	Baltimore.
Chalmette	2,982.96	1879	Philadelphia.	New Orleans.
Chattahoochee	2,676.35	1882	Chester, Pa.	Savannah, Ga.
City of Macon	2,092.80	1877	Philadelphia.	Savannah, Ga.
City of New York	3,019.56	1875	Chester, Pa	New York.
City of Pava	3,532.26	1878	Philadelphia.	New York.
City of Peking	5,079 62	1874	Chester, Pa.	New York.
City of Savannah	2,029.40	1876	Philadelphia.	Savannah, Ga.
City of Sidney	3,016.76	1875	Chester, Pa.	New York.
City of Tokio	5,079.62	1874	Chester, Pa.	New York.
City of Wash'gt'n	2,618.27	1877	Philadelphia.	New York.
Clyde	2,016 71	1870	Philadelphia.	New York.
Colina	2,905.64	1873	Chester, Pa.	New York.
Colon	2,685.75	1873	Chester, Pa.	New York.
Colorado	2,764 84	1879	Chester, Pa.	New York.
Columbia	2,712.89	1880	Chester, Pa.	Portland, Or.
Granada	2 573 38	1873	Wilmington, Del.	New York.
Guyandotte	2 350.57	1882	Chester, Pa.	New York.
H. F. Dimock	2,625.93	1884	Philadelphia.	New York.
Illinois	3,101 77	1873	Philadelphia.	Philadelphia.
Indiana	3,101.77	1873	Philadelphia.	Philadelphia.
Lone Star	2 255 39	1875	Wilmington, Del.	New Orleans
Louisiana	2,840.33	1880	Chester, Pa.	New York.
Mariposa	3,158.23	1883	Philadelphia.	San Francisco.
Morgan City	2 270.97	1876	Wilmington, Del.	New Orleans.
Nacooehee	2,680.00	1882	Chester, Pa.	Savannah, Ga.
New York	2,846.56	1875	Wilmington, Del.	New Orleans.
Niagara	2,265.28	1877	Chester, Pa.	New York.
Ohio	8,101 04	1873	Philadelphia.	Philadelphia.
Pennsylvania	3,104.28	1873	Philadelphia.	Philadelphia.
Queen of Pacific	2,727.80	1882	Philadelphia.	San Francisco.
Roanoke	2,354.38	1882	Chester, Pa.	New York.
Tallahassee	2,677.41	1882	Chester, Pa.	Savannah, Ga.

COASTWISE STEAMSHIP AND STEAMBOAT LINES.

A number of the steamships named above, various other steamships and a number of steamboats are employed in coastwise, lake, or river transportation. The list of companies or lines engaged in such operations in 1887 included the following: Androscoggin Lake Transportation Company; Arkansas River Packet Company; Baltimore and Savannah Line; Baltimore, Chesapeake and Richmond Steamboat Company; Bay Line (running on the Chesapeake); Benton Transportation Company (running on the Missouri river); Boston and Bangor Steamship Company; Boston, Norfolk, Washington and Baltimore Line (Merchants' and Miners' Transportation Company); Brunswick and Inland Steamboat Company; Central Line of boats (plying the Chattahoochie, Apalachicola, and Flint rivers); Colgrove's Transportation Line; Cross River route (from Rome, Ga., to Greenpoint, Ala.), Crooked Lake Navigation Company (New York); De Bary-Baya Merchant's Line (St. John's river, Florida) Deseronto Navigation Company; Detroit and Cleveland Steam Navigation Company; Diamond Jo Line steamers (between St. Louis and St. Paul); East Coast Steamboat Company (of Florida); Fall River Line (Old Colony Steamboat Company); Georgia and Florida Steamboat Company; Independent Line steamers (St. John's river, Florida); International Steamship Company (line between Boston, Portland, Eastport, and St. John, N. B.); Keuka (Lake) Navigation Company; Kissimmee City and Fort Bassinger steamers (Florida); Lake Hopatcong Steamboat Company; Lake Superior Transit Company; Mallory's Steamship lines (New York and Texas Steamship Company); Maryland Steamboat Company; Memphis and Vicksburg Packet Company; Memphis and White River Packet Company; Merchants' and Planters' Line of steamers (plying the Chattahoochie, Flint, and Apalachicola rivers); Missouri River Packet Company (operating between Sioux City, Iowa, and Bismarck, Dakota); Missouri River Transportation Line; Nashville, Paducah and Cairo, and Nashville and Evansville Packet companies (operating on Cumberland, Ohio, and Mississippi rivers); Natchez and Vicksburg Packet Company; New Bedford, Martha's Vineyard and Nantucket steamers; New York and Charleston Steamship Company; Norfolk and Washington Line of steamers; Norwich and New York Transportation Company (Norwich and Worcester Steamship Line); Ocean Steamship Company, of Savannah (Philadelphia and Savannah Line); Old Dominion Steamship Company; Ontario and St. Lawrence Navigation Company; Owego Steam Navigation Company; Pacific Coast Steamship (steamers sailing from San Francisco for ports in California, Oregon, Washington and Idaho Territories, British Columbia and Alaska); Paducah and Cairo Daily Packet Company; Parisot Line (Mississippi and Yazoo River Packet Company, plying from the Mississippi and Ohio rivers to the Yazoo, Tallahatchie, Sunflower, and Tehula rivers); People's Line steamers (St. John's river, Florida); Pittsburgh and Cincinnati Packet Line; Plant Steamship Line (plying between Tampa, Key West, and Havana); Portland Steam Packet Company (plying between Boston and Portland); Potomac Steamboat Company (plying between Washington, Old Point Comfort, and Norfolk); Providence, Norfolk, West Point and Baltimore Line; Red River and Coast Line (plying between New Orleans and Jefferson, Texas, Shreveport, and all points on Red river to the head of navigation); St. Louis and Mississippi Valley Transportation Company (St. Louis and New Orleans Freight Line); St. Louis and St. Paul Packet Company; St. Louis, Ohio and Tennessee River Packet Company; Savannah and Baltimore Line; Seneca Lake Steam Navigation Company; Star Line steamers (plying between Detroit and Port Huron); Stonington Line steamers; West India Fast Mail route (plying between Tampa, Florida, and Havana).

MERCHANT STEAM TONNAGE AND TRAFFIC.

The geographical distribution, tonnage, and earnings of the steam craft of the United States, exclusive of 143 vessels used on state waters with no navigable outlet, and not subject to customs and inspection laws of the United States, in 1880, was as follows:—

	Number of Steamers.	Tonnage.	Gross earnings.	From passenger traffic. Number.	Freight traffic, in tons.
Total	4,778	1,194,888.98	$83,903,537	167,683,106	24,819,523
New England group	463	118,533.74	7,849,828	15,474,710	2,610,416
Northern lakes	947	222,290.45	12,136,228	1,356,010	4,368,171
Upper Mississippi river	366	83,918.09	7,668,864	1,299,553	3,500,035
Ohio river	473	107,472.48	7,628,924	3,961,798	2,446,353
Middle states	1,459	432,803.26	31,856,519	136,653,282	7,217,415
Lower Mississippi river	315	48,303.06	4,168,989	1,385,357	1,276,972
Gulf of Mexico	126	41,610.67	2,806,310	79,260	694,343
South Atlantic coast	266	30,833.13	2,598,709	1,787,065	553,222
Pacific coast	319	97,004.88	6,362,770	6,604,712	2,087,293
Upper Missouri river	44	12,099.22	826,596	81,359	65,303

A large proportion of all the steam craft of the United States consists of ferry and towing boats.

IMPROVEMENTS IN COASTWISE STEAMERS.

Comparing the speed, equipment, and cost of running our coastwise steamers now and a few years ago, a marine engineer says: "Coastwise steamships of the 1873 type of 1,200 tons, had a carrying capacity of 1,900 bales of cotton, an average speed of ten miles an hour, or a consumption of 28 tons of coal per twenty-four hours. The engineer's crew consisted of a chief and three assistant engineers, three oilers, six firemen, and six coal passers. There were only three steam pistons to pack, two of the main and one of the donkey-pump engine. In the modern-built steamship of 1885 there are thirty steam pistons to pack. The average gross tonnage of the propeller steamship of the present time is 2,500 with a carrying capacity of 5,000 bales of cotton, and a speed of 13 miles per hour on a consumption of about thirty tons of coal per day. The engineer's crew on these large ships are the same as they were on the old small ones with the exception of one assistant engineer less." From the foregoing it appears that the speed increased nearly one-third and the carrying capacity more than doubled without any corresponding increase in the crews employed, owing to improved machinery and its more general substitution for hand labor, which facts must go a long ways toward solving the problem "how to navigate ships profitably."

LAKE TRANSPORTATION SERVICE.

A review of lake transportation service up to 1877 embraced the following statements:—

"In 1845 there were upon the lakes above Niagara Falls 60 steamers, 8 of which were propellers; 270 schooners, and 50 brigs, with an aggregate of 76,000 tons. There were on lake Ontario 13 steamers, 6 of which were propellers, and 100 sail vessels, with an aggregate tonnage of 18,000. The estimated value at that time was $5,500,000. Ten years later the number of craft on the lakes increased to the following: Steamboats, 110; propellers, 97; schooners, 639; brigs, 101; barques, 33; sloops and scows, 216; tonnage, 237,830. The value was estimated to have reached $10,000,000. From that time onward the growth was very rapid. Three years later the tonnage had reached 387,740, and the valuation $15,000,000. The number of steamers had increased to 312, and sail vessels to 1,130.

In 1862 the classification was as follows: Steamers, 396; schooners, 1,066; barques, 74; brigs, 85; sloops, 16; total tonnage, 412,127. The value then was estimated to be fully $23,000,000. The lake marine reached the height of its prosperity in 1872, when there were 868 steamers, with a tonnage of 172,483; 3,208 sail vessels, with a tonnage of 310,368, and 1,553 barges, with a tonnage of 254,453, making a total of 737,304 tons. The panic of 1873, and the subsequent business depression, have told heavily upon the lake trade, but this is believed to be only temporary, like the effect upon other departments of commerce. The number and tonnage of all the craft on the chain of lakes at the close of the year 1876 was as follows: Steam vessels, 885; tonnage, 190,367. Schooners, 1,282; tonnage, 273,682. Barques, 66; tonnage, 24,526. Brigs, 16; tonnage, 2,945. Sloops, 68; tonnage, 4,699. Scows, 179; tonnage, 8,541; making a total tonnage of 504,760, a falling off of over 200,000 tons. The number of steamers has remained about the same, and the number of sail vessels has been reduced nearly one-half. The depreciation and decrease in value have been even more."

In 1880 the number of steam craft plying on the northern lakes, exclusive of vessels identified with canal interests, was 947, of which 397 belonged to Michigan, 114 to Wisconsin, 89 to Illinois, 117 to Ohio, 26 to Pennsylvania, and 204 to New York.

TRANSPORTATION IN BARGES ON THE LAKES.

Much attention was given at various periods to barges in connection with economical internal transportation. An address delivered by Mr. Richmond, president of the Buffalo Board of Trade, embraces the following statements:—

"No longer ago than 1850 the most spacious propeller on the great lakes could carry only 600 tons. Gradually the size has been enlarged, until some of the propellers carry from 2,000 to 2,500 tons. In 1861 the modern and economical system of transportation in barges on the great lakes is said to have been first introduced. Its result has been a wonderful reduction in the cost of freightage. It was first used in the lumber trade, where it was highly successful, and now nearly all the lumber brought to Buffalo and Tonawanda is carried in barges, in lines of four, five, or six, towed by propellers or steam tugs. Thus a million and a half or two millions of feet are brought in each tow. Lumber is brought from Bay City, in Michigan, to Buffalo, a distance of about 500 miles, at the low charge of $1.25 per thousand feet."

In this and in all his other statements regarding rates of freight Mr. Richmond adduces actual facts.

"It was not until 1871 that the use of a propeller with one barge attached for the carriage of grain on the great lakes was first introduced. It may be said to have revolutionized the business. Large numbers of 'tows,' each consisting of a propeller and its consort, and carrying from 100,000 to 120,000 bushels, were subsequently employed."

Mr. Richmond gives instances showing that on large vessels having a return cargo of coal at the low rate of 60 cents a ton, free in and out, from Buffalo to Chicago, a distance of about 1,000 miles, corn could be brought on large sailing vessels from Chicago to Buffalo for two cents a bushel at a profit, and that where a propeller and an accompanying barge are used the profit was much greater. In 1866 the average lake freight on corn from Chicago to Buffalo was 11½ cents, and in October of that year the average was over 15 cents.

BARGE MOVEMENT OF COAL DOWN THE OHIO FROM PITTSBURGH.

An article published in the Pittsburgh Commercial in 1883 says:—

"There are about 1,500 barges and 600 coal boats engaged in the transportation of coal. The barges are usually 130 feet long by 24 feet wide, and will carry from ten to fourteen thousand bushels of coal. They cost from $12,000 to $15,000 each. The coal boats are about 170 feet long and 26 feet wide, and hold from twenty to twenty-five thousand bushels. The boats cost from $600 to $750 each. Their bottoms are made up along the Allegheny river and floated down here, where their sides of 1½ inch planking are added. The barges are always brought back, but the boats, which go to New Orleans, are usually there sold and broken up. A boat sold at the New Orleans levee brings from $100 to $250. Its planks are resold and its timbers often cut up into firewood. On an average stage of water it takes from four to five weeks to run a tow from here to New Orleans, and about three weeks to come back with empties. Two hundred thousand bushels are considered a good tow from here to Louisville, but from there down the lower river, and frequently to the New Orleans district, which comprises the entire 'sugar coast,' the tows run from five hundred to six hundred thousand bushels. The Joe Williams went down this spring with 700,000 bushels. About 40 per cent. of the coal shipped goes to Cincinnati for local consumption. Louisville stands next in order as a consumer, and after it New Orleans. Memphis and Vicksburg are about the same in size of demand.

From Paducah the Tennessee and Cumberland district are supplied, and from Memphis and Vicksburg the Arkansas, St. Francis, and White river districts. New Orleans shipments comprise the supply for the 'sugar coast,' embracing the Teche, Tchafalayah, and the country in the vicinity of Brashear city. Some forty millions of bushels are annually sent from here to Cincinnati, which city is Pittsburgh's largest customer. Next in order comes New Orleans, which takes from eighteen to twenty million bushels; Louisville some fifteen million, and Memphis and Vicksburg about ten million. In speaking of the 'take' of these different points, the names of the cities mentioned are used to designate the entire districts they supply. The average cost of sending coal from here to Cincinnati is about two cents per bushel, and from here to New Orleans from three and a half to four cents.

Of course these figures are not definite, but they express a carefully calculated average. The boat trade of the lower Mississippi consumes a large amount of coal. There are various coaling stations, the most prominent being that of the Browns, at Arkansas City. 'Wooding up' on the Mississippi is a thing of the past. The boats all carry a small supply of wood to start or hasten fires, but coal is the fuel used. There is rarely a stop made to receive it. The ladened coal barge is floated out into the stream, and the steamer picks it up as she goes along, and after relieving the barge of its load, casts it adrift on the tide. The empty barge then floats to some point where it is picked up by a tugboat and conveyed to the fleet of empties that awaits transportation up the river. A tow from here destined for the lower river usually employs from thirty to thirty-five hands, who principally reside in this vicinity. The strongest, largest, and costliest towboats in the world are used, and the only other marine structures that can be compared with them at all, are some of the North river towboats used for convoying canal fleets from Albany to New York, such as the Niagara and others. But there is no more similarity between the manner of towing on the Hudson and on the Ohio than there is between the boats employed. The Hudson river boats are long structures, tapering from amidship to stern and bow, with paddle-wheels at the sides, of deep draught, and with boilers under the water line. They really 'tow,' *pulling* their convoy with long ropes attached to the stern. Our Ohio boats are 'wheelbarrows,' with wheels behind, boilers on deck, of light draught, and 'butt' their tows ahead of them. Eastern boatmen cannot understand how we do it, but the most powerful towboat on the Hudson (and they are the most powerful in the salt water world) could not budge a lower river coal fleet with its rope arrangements."

BARGE MOVEMENT OF GRAIN.

There is also a considerable movement of grain in barges on western rivers. Some idea of its characteristics may be formed from the following statement, made a few years ago, in the St. Louis Republican:—

"If any one imagines that a towboat and barges cannot carry a good paying load they can find a cure for their unbelief by noting the following cargo of the tow-boat Bee, which arrived in New Orleans last Saturday: 4,371 barrels flour, 1,296 barrels meal, 1,090 barrels grits, 5,258 sacks corn, 802 sacks oats, 651 sacks bran, 1,296 packages lard, 204 packages meat, 150 bales of hay, and 24,992 bushels of bulk corn. One hundred barrels of flour is a car load; consequently, this tow-boat had 44 cars of flour on board. That would make two good freight trains. Add 13 cars of meal, 11 cars of grits, 6 cars sacked corn, 4 cars of oats, 2 cars of bran, 6 cars of lard, 1 car of meat, 3 cars of hay, and 75 cars of bulk corn, the grand total of the car loads of this one cargo would be 155."

A Kansas City journal, in discussing barges, says:—

"We have never seen one, but, as we read about them, $15,000 to $25,000 is the cost, and they carry from 15,000 to 35,000 bushels of grain each. The hulls are strong, and built with bulkheads of light draft. The expense of operating is said to be $75 to $100 per day. The speed is not given, but ten miles an hour down stream ought to be made without difficulty as an average, and half that up river. This would give three days to St. Louis down, and four days back. We count sixteen hours running time per day down the river, and all hours up, in all seven days, or, at outside figures for expense, $700; at inside figures, $505. Now, a load of grain of 15,000 bushels at 5 cents would aggregate $750; at 10 cents, $1,500. A load of 35,000 bushels would be $1,500 and $3,000. In this no account is taken of back loads."

WESTERN RIVER STEAMBOAT MOVEMENTS.

The relative magnitude of steamboat movements on the western rivers has been greatly diminished by the success of barges as freight carriers and the numerous opportunities afforded of utilizing competitive railway lines in passenger and freight service. A considerable field for steamboat operations still exists, however, and many fine steamers were built at comparatively late periods.

Col. John W. Forney, in describing a steamboat on which he was journeying down the Mississippi in June, 1872, said:—

"Pittsburgh and Cincinnati have been the chief manufacturing cities of the western steamboats, including their magnificent engines, while Madison, Jefferson City, and New Albany, Indiana, have also become famous therefor. The builder after whom this splendid palace is named, James Howard, has turned out from his slips at Madison, Indiana, 400 steamboats. The length of the hull of the Howard is 330 feet, breadth of beam 55 feet, depth of hold 10 feet, extreme width 96 feet, carrying capacity 3,400 tons, although 4,000 tons may easily be freighted on her. The state-rooms are superb, containing large bedsteads, wardrobes, and washstands, with every convenience of bed chambers at home. The dining-room is a gorgeous saloon, and is upholstered and decorated in a style equal to poor Fisk's gaudy sound boats."

He also stated that a round trip between Louisville and New Orleans could then be made in 14 days. When steamboats first commenced running between these points the time required was 45 days. A notable trial of steamboat speed occurred in June, 1870, in a race between the Robert E. Lee and Natchez. The Lee was victorious, making the journey from New Orleans to St. Louis, 1,278 miles, in 3 days, 18 hours, and 14 minutes.

HOW THE RAILWAYS AND BARGES SUPERSEDE THE STEAMBOATS.

The Pittsburgh Telegraph published an interesting article a few years ago on the failure of a line of seven barge steamers, organized in the fall of 1880 to carry freight between Pittsburgh, St. Louis, and other river towns. Only one of the boats had continued in service.

"'What has done this?' was asked of Mr. Charles Fairman, the well-known steamboat agent of this city. The gentleman promptly replied:—

'It is not a long story, but an interesting one. When the Big Seven boats began their trips things were booming here. Railroads were charging 26 cents per 100 for heavy freight to St. Louis, and the boats could do it nicely for 15 cents, leaving a 11-cent margin in their favor. This was too good to last. June 13th, 1881, the railroads dropped to 20 cents, and low water kept the boats idle for nearly six months. When they started up again in November, 1881, they dropped to 12½ cents (per 100 pounds) for St. Louis freight, and still had a margin of 7½ cents in their favor. Then the railroads did what no one expected would be done. They gave outlying manufacturing towns, such as McKeesport, Johnstown, &c., through rates to St. Louis, and abolished charges from such towns to this city. For instance, the old rate from the Cambria Iron Works, Johnstown, to St. Louis was 43 cents per 100. It then became 26 cents. This cost the boats 3,000 tons a year; the same in the case of McKeesport, where the tube works sent lots of freight by river. They got a through rate to St. Louis so low that one shipper who chose the river was out the amount of the insurance on his freight. Then there was another blow. You know the bottle factories of this city ship immense quantities of these goods. Formerly these were carried by our boats; but the building of new roads, and the construction of switches to the works, and the shipping in bulk, killed the thing for the boats.'

'What do you mean by shipping in bulk?'

'Why, this thing of making a packing box out of a box car. The railroads send a car right into the bottle house; the floor is laid with straw, and the bottles are packed right in that car, and don't leave it until it rolls into the warehouse at St. Louis. This suits the bottle men so well that the boats couldn't get the trade if they paid a dollar a ton for this freight. But the last blow,' continued Mr. Fairman, 'was the worst. It was the last straw for the camel's back.'

'And what was the straw?'

'It was Jay Gould's abominable barges. They were built here, some of them, and were big, almost as Noah's ark, and resembled that vessel in many respects. Well, no one ever expected that these monsters would come prowling up the river again to cut into the steamboats, but they did. When Gould's purpose had been served, and the barges were no longer needed to take wheat and corn to New Orleans from St. Louis, the barges were brought here by tow-boats. They took St. Louis heavy freight for 10 cents, against the steamboats' 12½. Then the unfortunate Big Seven came down to 10 cents, and then those wretched barges tumbled to 8 cents. That settled the business and so it stands to-day.'

Captain Evans was not in the best of humor over the state of affairs. He said that among the disadvantages under which boats labored, aside from freight troubles, was this matter of attaching for wages. A big steamer, under existing laws, can be subjected to the most costly delays by some worthless deck-hand. Railroads know no such hindrances, and they have other advantages over boats everywhere.

Meanwhile the Cincinnati packets are doing fairly well, leaving regularly with good trips, and reaching many points as yet beyond the reach of the railroads."

RATES OF WESTERN RIVER TRANSPORTATION.

The following statements show the charges for western river movements between different points at various periods:—

Average freight charges from St. Paul to St. Louis by steamers for seventeen years, distance 800 miles.

	1856. Cts.	1857. Cts.	1858. Cts.	1859. Cts.	1860. Cts.	1861. Cts.	1862. Cts.	1863. Cts.	1864. Cts.	1865. Cts.	1866. Cts.	1867. Cts.	1868. Cts.	1869. Cts.	1870. Cts.	1871. Cts.	1872. Cts.
Wheat per bushel	18	15	14	15	16	15	18	19	25	24	23	21	20	20	18	15	15
Flour per barrel	60	50	50	50	52	50	60	62	75	73	72	70	68	68	60	50	50
Barley per bushel	14	12	11	12	12	12	14	14	19	19	18	16	15	15	15	12	12

Average freight charges from St. Louis to New Orleans, by the Barge Line, for seven years.

Articles.	1866. High water.	1866. Low water.	1867. High water.	1867. Low water.	1868. High water.	1868. Low water.	1869. High water.	1869. Low water.	1870. High water.	1870. Low water.	1871. High water.	1871. Low water.	1872. High water.	1872. Low water.
Flour per barrel	$0 45	$0 55	$0 54	$0 73	$0 31	$0 49	$0 30	$0 40	$0 38	$0 56	$0 26½	$0 65	$0 43	$0 77
Corn per bushel	0 12 3/5	0 15 3/5	0 15 1/3	0 20½	0 08 7/10	0 13 3/4	0 08 3/5	0 11 1/5	0 10 3/5	0 15 7/10	0 07½	0 18 1/5	0 11	0 21 3/5
Rye per bushel	0 12 3/5	0 15 3/5	0 15 1/3	0 20½	0 08 7/10	0 13 3/4	0 08 3/5	0 11 1/5	0 10 3/5	0 15 7/10	0 07½	0 18 1/5	0 11	0 21 3/5
Oats per bushel	0 07 1/5	0 08 4/5	0 08 3/5	0 11 7/10	0 05	0 07 4/5	0 04 4/5	0 06 3/5	0 06 1/10	0 09	0 04 3/10	0 10 3/5	0 06 9/10	0 12 3/10
Bacon per 100 pounds	0 22½	0 27½	0 27	0 36½	0 15½	0 24½	0 15	0 20	0 19	0 28	0 13 3/5	0 82½	0 21½	0 38½
Ham per 100 pounds	0 22½	0 27½	0 27	0 36½	0 15½	0 24½	0 15	0 20	0 29	0 28	0 13 3/5	0 32½	0 21½	0 38½
Pork per barrel	0 67½	0 82½	0 81	1 09½	0 46½	0 83½	0 45	0 60	0 57	0 84	0 40	0 97½	0 64	1 15½
Beef per barrel	0 67½	0 82½	0 81	1 09½	0 46½	0 83½	0 45	0 60	0 57	0 84	0 40	0 97½	0 64	1 15½
Lard per 100 pounds	0 22½	0 27½	0 27	0 36½	0 15½	0 21 3/8	0 15	0 20	0 19	0 28	0 13 3/5	0 32½	0 21½	0 38½
Hay per 100 pounds	0 32½	0 37½	0 37	0 46½	0 25½	0 34½	0 25	0 30	0 29	0 38	0 23 3/5	0 42½	0 31½	0 48½

NOTE.—High water rates include months of April, May, June, July, and August. Low water rates balance of year. In 1873 for months of January, February, and March the rate for flour averaged 82 cents per barrel, for April, May, June, and July 28¾ cents per barrel.

Statement prepared by George H. Wagner, Secretary Union Merchants' Exchange of St. Louis, showing average freight charges, by steamboat, from St. Louis to New Orleans, during the seven years, 1866 to 1872, inclusive:—

	1866. Cts.	1867. Cts.	1868. Cts.	1869. Cts.	1870. Cts.	1871. Cts.	1872. Cts.
Wheat per bushel	24 3/4	31	17	17 1/10	22 3/5	..	..
Flour per barrel	75	92 4/5	51	46 1/4	64	68	71 1/4
Corn per bushel	23 7/10	28 3/4	16	16	20 3/4	20	20
Rye per bushel	23 7/10	28 3/4	16	16	20 3/4	20	20
Oats per bushel	13 1/5	16½	9	9 1/10	11 3/4	11½	11½
Bacon per 100 pounds	41 1/5	51½	28 1/5	28½	37	36	36 3/4
Hams per 100 pounds	41 1/5	51½	28 1/5	20½	37	36	36 3/4
Pork per barrel	114	141	86	71	104	106	108
Beef per barrel	114	141	86	71	104	106	108
Lard per 100 pounds	41 1/5	51½	28 1/5	28½	37	36	36 3/4
Hay per 100 pounds	41 1/5	51½	28 1/5	28½	37	45½	36

Highest and lowest rate of freight charged on grain in sacks and flour per barrel, on the Mississippi, between St. Louis and New Orleans, from 1850 to 1860, inclusive:—

	Grain per bushel. Lowest. Cents.	Grain per bushel. Highest. Cents.	Flour per barrel. Lowest. Cents.	Flour per barrel. Highest.
1850	8	15	18	$0 62½
1851	7	17	22½	0 60
1852	5	14	20	0 50
1853	6¼	25	20	1 25
1854	9	25	25	1 25
1855	9	35	15	1 20
1856	12½	40	25	1 00
1857	10	32½	25	1 00
1858	10	20	35	0 60
1859	11½	40	15	0 90
1860	11	45	18	1 00

Average freight charges, highest and lowest prices, from St. Louis to New Orleans by steamer in 1866 and 1872.

	1886.			1872.		
	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.
Wheat per bushel...	$0 24¾	$C 15	$C 45	$....	$....	$....
Flour per barrel....	0 75	0 40	1 50	0 71½	C 30	1 25
Corn per bushel....	0 23 7/10	0 14	C 41 3/10	0 20	C 09⅘	6 36⅖
Rye per bushel.....	C 23 7/10	0 14	0 41 3/10	0 20	0 09⅘	0 36⅖
Oats per bushel.....	0 13⅕	0 08	0 24	0 11½	0 05⅗	0 20⅘
Bacon per 100 lbs...	0 41⅕	0 25	0 75	0 36⅔	0 17½	0 65
Hams per 100 lbs...	0 41⅕	0 25	0 75	0 36⅔	0 17½	6 65
Pork per barrel.....	1 14	0 60	2 00	1 08	0 45	1 90
Beet per barrel.....	1 14	0 60	2 00	1 08	0 45	1 90
Lard per 100 lbs....	0 41⅕	0 25	0 75	0 36⅔	0 17½	0 65
Hay per 100 lbs.....	0 41⅕	0 25	0 75	0 46	0 30	0 75

STEAMBOAT CHARGES BETWEEN PITTSBURGH AND NEW ORLEANS IN FALL OF 1874.

Thomas Sherloch, interested in steamboats, testified at Cincincinnati before Senate committee on transportation to seaboard, in October, 1874, as follows: "The general charge (for moving heavy freight) from Pittsburgh to Louisville and Cincinnati is from $3 to $4 per ton on fourth-class freight, or say from $2.50 to $4." Distance about 650 miles from Pittsburgh to Louisville, and about 500 miles from Cincinnati to Pittsburgh. Rates named cover almost everything carried on the river, "light freight, heavy freight, rolling freight, and sack freight, everything. We do not discriminate on the river, as railroads do, between first, second to third and fourth class, except when we connect with railroad lines, and are governed by their rules." Freight charges from Louisville to New Orleans are about the same as from Cincinnati to New Orleans. "We have what we call a very good river here now. There is probably 16 feet of water between here and Louisville; probably 12 feet all the way out of the Ohio river. Freights are now from $7 to $9 per ton to New Orleans from Cincinnati. Distance, 1,550 miles." Freight from Pittsburgh to New Orleans would probably be $2 a ton more than that, making from $9 to $11, and the distance about 2,000 miles. "These prices are now the asking prices. Prices will be still lower, probably in a few days, as soon as the yellow fever gets out, so that boats are willing to leave here and go down the river. It will reduce the rates probably from $1 to $2 a ton from these prices. . . . Railroads compete very seriously in steamboat business between Louisville and New Orleans. They divide the business between us. Q. Do they divide the freightage equally? A. No, I think not. I think we carry more freight than either of the railroads, and probably more together. Q. How about passenger traffic? A. I think we carry as many passengers on the boats, as we are running them now, as either of the roads do; not as both, but as either. We charge between Cincinnati and Louisville $3.50, which includes the state-room and the dinner, supper, and whatever meal they take on the boat. Railroads charge the same sum, but give no meals."

COST OF EARLY STEAMBOAT MOVEMENTS ON THE MISSOURI.

In documents presented by A. Whitney to Congress, in connection with a memorial praying for a land grant for a Pacific railroad, in 1848, is a statement made by Capt. Joseph A. Sire, who said he had been in the employment of Messrs. Chouteau & Co., and navigated boats on the Missouri for twenty-five years, in the course of which he said: "During the five months of low water it requires fifteen days from St. Louis to Council Bluffs, and the cost of transportation $2.50 per hundred pounds. . . . . . During the high water the current is very rapid, and would require from St. Louis to the Yellowstone from forty-five to fifty days, and would cost for transportation $8 for one hundred pounds. At low water the river (Upper Missouri) cannot be navigated, as there is not over two feet. Between the high and low water the passage may be made in thirty-five to forty days, because the current is not so rapid, and about fifty tons of freight might be taken up at a cost of from $5 to $6 per hundred pounds."

LAKE FREIGHTS.

Statement showing the average rates of lake freights on wheat and corn between Chicago and Buffalo during each month in eighteen years; the highest rate on wheat in each year, and the average rate on wheat in each year:—

	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1861, wheat.......	7.2	6.8	5.7	10.0	14.0	18.6	16.0
1861, corn........	6.3	6.3	5.2	8.8	12.0	17.2	14.7
Highest rate on wheat during 1861, 26 cents.							
Average on wheat for season 1861, 11 cents.							
1862, wheat.......	6.8	8 5	12.0	7.4	10.5	12.8	15.3
1862, corn........	7.1	7.6	11.0	6.6	9.5	11 8	14.2
Highest rate on wheat during 1862, 17 cents.							
Average on wheat for season 1862, 10.5 cents.							
1863, wheat.......	8.7	10.0	5.7	4.7	5.7	8.4	9.0
1863, corn........	7.8	9.0	4.9	4.2	4.7	7.2	7.7
Highest rate on wheat during 1863, 12½ cents.							
Average on wheat for season 1863, 7.5 cents.							
1864, wheat.......	8.5	13.4	6.8	8.2	8.0	8.2	13.7
1864, corn........	8.0	12.5	6.3	7.7	7.5	7.6	12.7
Highest rate on wheat during 1864, 18 cents.							
Average on wheat for season 1864, 9.5 cents.							
1865, wheat.......	7 3	6.6	8.3	7.1	11.6	14 9	12.3
1865, corn........	6 7	6 0	7.9	6.6	10.7	13.8	11.5
Highest rate on wheat during 1865, 19 cents.							
Average on wheat for season 1865, 9.7 cents.							
1866, wheat.......	12.5	15.6	11.6	10.3	12.7	17.4	13.5
1866, corn........	11.1	13.6	9.6	8 4	10.3	15.2	11.7
Highest rate on wheat during 1866, 23 cents.							
Average on wheat for season 1866, 13.4 cents.							
1867, wheat.......	5.5	5.5	4.7	5.5	8.1	9.3	9.0
1867, corn........	4.2	3.7	3.8	4.t	7.0	7.9	7.0
Highest rate on wheat during 1857, 15 cents.							
Average on wheat for season 1867, 6.8 cents.							
1868, wheat.......	5.2	5.3	4.2	7.8	9.1	8.8	9.3
1868, corn........	4.0	4.2	3.6	6.6	7.7	8.7	8.3
Highest rate on wheat during 1868, 13½ cents.							
Average on wheat for season 1868, 7.1 cents.							
1869, wheat.......	5.8	6.5	4.8	5.0	6.5	7.4	10.2
1869, corn........	5.8	5.6	4.5	4.8	6.0	6.9	9.3
Highest rate on wheat during 1869, 10 cents.							
Average on wheat for season 1869, 6.6 cents.							
1870, wheat.......	5.0	6.2	5.3	5.0	5.6	7.7	8.5
1870, corn........	4.4	5 5	4.5	4 7	4.2	7.3	7.6
Highest rate on wheat during 1870, 10 cents.							
Average on wheat for season 1870, 6.2 cents.							
1871, wheat.......	4 5	5.7	5.2	6.2	9.6	13.2	10.1
1871, corn........	4.1	5 3	4.8	5.7	9.0	12.3	9.7
Highest rate on wheat during 1871, 18 cents.							
Average on wheat for season 1871, 7.8 cents.							
1872, wheat.......	8.1	8.3	8.2	9.6	14.8	16.5	12.4
1872, corn........	7.4	7.8	7.7	8.8	13.8	15.5	11.4
Highest rate on wheat during 1872, 19 cents.							
Average on wheat for season 1872, 11.1 cents.							
1873, wheat.......	7.4	6.5	6.1	6.5	12.6	7 8	7.4
1873, corn........	6.5	5.8	5.5	5.7	11.6	6.9	6.9
Highest rate on wheat during 1873, 14 cents.							
Average on wheat for season 1873, 7.8 cents.							
1874, wheat.......	4.5	4.2	3 3	3.1	3.5	4.1	4.6
1874, corn........	4.0	3.9	3.6	2.1	3.2	3.8	4.2
Highest rate on wheat during 1874, 6 cents.							
Average on wheat for season 1874. 3.9 cents.							
1875, wheat.......	3.9	3.0	2.8	2.5	2.4	3.7	5.9
1875, corn........	3.6	2.6	2.6	2.2	2.2	3.4	5.5
Highest rate on wheat during 1875, 6⅜ cents.							
Average on wheat for season 1875, 3 5 cents.							
1876, wheat.......	3.0	2.5	1 9	2.2	2.6	4.4	3.7
1876, corn........	2.7	2.3	1.7	1.8	2.3	4.0	3.3
Highest rate on wheat during 1876, 5 cents.							
Average on wheat for season 1876, 2.9 cents.							
1877, wheat.......	3.5	2.4	2.6	4.0	4.0	4.9	4.5
1877, corn........	2.9	1.9	2.2	3.6	3.4	4.4	3.9
Highest rate on wheat during 1877, 6 cents.							
Average on wheat for season 1877, 3.7 cents.							
1878, wheat.......	2.5	2.1	1.7	3.3	4.4	3.6	4.5
1878, corn........	2.2	1.8	1.5	3.0	4.1	3.3	4.1
Highest rate on wheat during 1878, 7 cents.							
Average on wheat for season 1878, 3.1 cents.							

IMPROVEMENTS OF PHYSICAL CONDITION OF RAILWAYS.

THE substitution of steel rails for iron rails, which commenced progressing during the eighth decade on an extensive scale, was frequently accompanied with other notable improvements of the physical condition of railways and rolling stock. In the aggregate these changes were of immense importance, as they cheapened the cost of freight movements on leading thoroughfares to an unparalleled extent, and greatly increased the speed, safety, and comfort of passenger movements. While a number of the advances were rapidly adopted, there were so many variations in the financial condition, characteristics of traffic, and proclivities of the managements of different lines, that uniformity of action at a given time, on any subject, was unusual, and no general remarks can be applicable to all lines at any particular period.

These improvements effected a radical transformation of prominent American railroads, from a relatively low type to the highest type, in nearly all matters relating to the economic movement of large quantities of freight. Instead of the cost of such movements, per ton per mile, being about twice as great in the United States as in the United Kingdom, as was the case before 1860, many American movements are now (1887) made at about half the cost of corresponding English railway labors. The greatest contrast in the practice of the two countries is probably presented by differences in rolling stock and methods of making up trains. After American road-beds were advanced to a standard approximating present excellence improvements in rolling stock and operating methods were promoted rapidly in the United States, while progress was slow in Great Britain, so that economic conditions were reversed, and one of the greatest of all modern mechanical triumphs was achieved in this country.

It was a common remark among practical railway managers towards the close of the eighth decade and subsequently that the reductions in the cost of freight movements which they had witnessed were regarded as impossibilities when the spur of necessity first compelled the efforts by which those reductions were finally achieved.

It would be impossible to fully explain how these feats were accomplished, and how progress is steadily being maintained, but as they form the most important of all features of American transportation development, in their bearing upon industrial welfare, an attempt will be made to give an outline sketch of their leading characteristics.

The improvements in the physical condition of the railroads embraced

NOTABLE ADVANCES IN ALL VITAL MATTERS

affecting the condition of the permanent way, including every detail relating to tracks, ballast, rails, joints, switches, frogs, bridges; the construction of additional sidings and second, third, and fourth tracks; the erection of numerous depots, stations, and a great enlargement of terminal facilities; the adoption of methods of signaling which rendered it possible to materially increase the number of trains that could be safely sent over a line during a given period; notable additions to the number and marked improvements in the equipment of railway shops.

These improvements rendered possible great additions to the weight and capacity of locomotives and freight cars, and facilitated the adoption of better methods of making up and running freight trains. Transshipments of the freight forwarded over long distances were avoided to an extent that was formerly impossible by the consolidation of connecting roads, operation of fast-freight-line systems, and the interchange of cars between different roads. On a number of lines the speed of freight trains was materially increased, and means were devised for increasing the amount of service obtained from locomotives during a given period, and the average train load.

About the beginning of the eighth decade a sharp contest between the east and west trunk lines temporarily reduced through rates to unprecedentedly low figures, and it became evident then that a gigantic struggle was impending. In the series of preparations for it the New York Central relied largely upon the advantages it would derive from the adoption of the expensive expedient of laying down four steel-rail tracks over its main line at a time when steel rails were still selling at an enormous price; the Pennsylvania acquired control, by lease, of the United Railroads of New Jersey, thus extending its lines to Jersey City directly opposite the city of New York; it expanded its system southward to Washington city, and commenced making very extensive improvements in all matters relating to its tracks and rolling stock; the Baltimore and Ohio built expensive bridges over the Ohio river and made arrangements for extending its system to Chicago; the Erie, on account of various financial difficulties and contests for supremacy in its management, postponed important physical changes to a later date than its rivals, but also made vigorous strides in that direction during the decade.

Sundry other similar changes were simultaneously progressing in various portions of the country, but the east and west trunk-line contests presumably exerted a leading influence in hastening the great engineering and mechanical advances which occurred.

Steel rails were of vital consequence, as the basis of other improvements, because the continued use of such iron rails as were then procurable, on important roads, necessarily involved constant repairs and incessant watchfulness, on account of the frequency with which they were broken, and there was little or no prospect of the success and utility of thorough reforms while this difficulty remained unsurmounted. The assurance of an avoidance of this terrible source of trouble and embarrassment afforded time and encouragement for other desirable or necessary labors.

The bulk of the original outlays of railway companies, or main proportion of their capital account, is represented by the permanent way and fixed appurtenances, rather than by the rolling stock. Of the total permanent investments of all the railroads of the United States, reported in the census returns of 1880, amounting to $5,182,445,806.93, about four-fifths, or $4,112,367,175.83, were for construction of road, and only a little more than one-tenth of this sum, or $418,045,458.48, for equipment. In the current outlays of the census year $102,583,043.26 were devoted to the maintenance of the road and real estate; $54,985,340.51 to repairs of machinery and cars, and $195,231,736.98 to operating and general expenses. The net earnings were $227,650,473.51, or 39.22 per cent. of the total receipts. These figures indicate the relative financial significance of the grand divisions of railway affairs, and illustrate the importance of the road and real estate, not only as primary objects of expenditure, but as claimants for incessant new current outlays.

To construct a railway, keep it in proper order, and, if it is a progressive line, to provide expensive new improvements as rapidly as they are required, immense sums must be expended; and in view of the habit of constructing lines in an imperfect manner at the outset, which has always prevailed in this country, it is scarcely surprising that the capital accounts of many lines have been swelled to the extent shown by their reports. It may be said of American railways, as of many other things in this country, that they rarely or never were or are constructed in an approximately complete manner, and in the nature of things they cannot be, except in rare instances, because it is necessary that they should develop earning power before the many millions necessary to render them as complete as is desirable are engulfed. What happens is that they grow or improve in their characteristics as a pressing need for such improvements arises from growth of traffic, pressure of competition, new inventions, or other causes. The directions in which such growth should be made, and initial efforts towards creating a number of important improvements, received special attention during the eighth decade.

CONDITION OF ROAD-BED.

THE fundamental feature of a railway is the road-bed, approximately straight and level, as compared with ordinary roads, yet usually diverging widely from an ideal standard in these respects, on account of numerous curves and ascending or descending grades. These divergencies were unnecessarily frequent on many lines for the purpose of saving the expense of deep excavations, bridges, and tunnels, on account of the pressure of influential local interests or other causes; and one of the directions in which many improvements were gradually made was in straightening old lines and avoiding, as far as possible, heavy grades. As traffic increased the desirability of such changes was constantly intensified, as the extra cost of movements over a sharp curve or a steep grade multiplied as rapidly as the number of trains dispatched.

But it was, perhaps,

IN THE MATTER OF DRAINAGE,

that one of the most radical advances was made by a number of important lines. With all roads intended for constant use adequate provision for the prompt removal of falling water and the avoidance of the disturbing and disintegrating effects of alternate periods of freezing and thawing, is one of the first requisites; and with a railroad careful attention to this subject is absolutely necessary, as failure brings with it the penalties involved in the attempts to operate a line unsafe and unfit for the rapid movement of numerous trains. A newly constructed road-bed, which depends solely upon the material found at each point along the line for ballast, and which is not more carefully drained than was formerly common, frequently degenerates into the condition depicted by the expressive phrase "mud road," and this is practically what a number of American railroads formerly were, the mud sometimes flying in all directions before the march of the locomotive as freely as it flies on a common dirt road after a heavy rain when a vehicle is driven over it at a rapid pace.

One of the first stages of improvement is the application of a portion of the adjacent soil to the top ol the road-bed, under conditions which make it do duty as ballast, and it is styled mud ballast. When mud ballast is applied in the best possible manner it frequently proves highly serviceable, but roads that aim at considerable advances use other materials, including sand, gravel, locomotive cinders, furnace slag, and broken stone. As one of the objects in applying either of these materials is to raise the track above the main road-bed, they all presumably help to improve drainage, and their relative utility largely depends upon the extent to which that object is accomplished.

One method of classifying roads is as mud roads, mud-ballasted roads, gravel-ballasted roads, furnace-slag or locomotive-cinder-ballasted roads, and broken-stone-ballasted roads, and their respective merits are approximately indicated by the order in which they are named above. Much was to be learned, and much practical knowledge has been acquired and disseminated without exhausting possibilities of improvement, of ballast and drainage; the arrangements of the foundation on which tracks are laid, including the selection and adjustment ol ties, the fastening of rails to ties, and establishment of connections between rails, so as to avoid as far as possible the damaging effects of the apertures left at rail ends, necessitated by expansion and contraction; the proper laying of rails on curves, and straight and level stretches of road, and the construction of frogs and switches.

In spite of all that has been done, incessant labors are necessary to keep the best of tracks in unimpeachable condition, and on many lines imperfect drainage, deficient ballasting, antiquated switches, poor ties, and defective splices, or appliances for joining rails are constant sources of delays and dangers.

A prime requisite in all railway operations is safety, and in the long chapter of accidents that inevitably occur, it is scarcely possible to avoid some that are due to defects in the track. It is always exceedingly desirable to reduce their percentage to the smallest possible limits, however, and roads that have secured a large amount of business must also advance their tracks to a condition that renders it possible to daily forward many trains, some of which move at high rates of speed, without subjecting passengers, freight, and employés to dangers inherent in the permanent way, and unavoidable by any precautions that trainmen may adopt. The extent to which these objects are accomplished on many lines is remarkable and highly creditable in view of the numerous grade crossings existing in this country, as the accidents due to defects in track usually form only a comparatively small percentage of the total number that occur; but even in this matter there is often considerable room for improvement, and it is only by gigantic and continuous labors and incessant watchfulness that many tracks are prevented from being the source of numerous terrible disasters.

It is scarcely too much to say that before the eighth decade the road-bed and track of no railway line of considerable length in the United States had been advanced to a condition that would now be deemed creditable, and on progressive lines important improvements have been made in every essential feature.

One of the most thorough and significant changes was commenced on the main line of the Pennsylvania Railroad in 1872, with attempts to establish what soon became a standard track, which has received much attention and commendation. Printed forms or directions were furnished, and each supervisor was instructed to construct a mile of standard track according to specifications, which mile was to be completed by the middle of August, in time for the annual inspection of 1872. The whole amount of tbis preliminary work was only about ten miles, or one mile in about thirty-five or thirty-six of the main line, but the results were so satisfactory that the system adopted was, after a comparatively brief period, extended along the whole line, some of the details being improved. This standard in 1882 was as follows:—

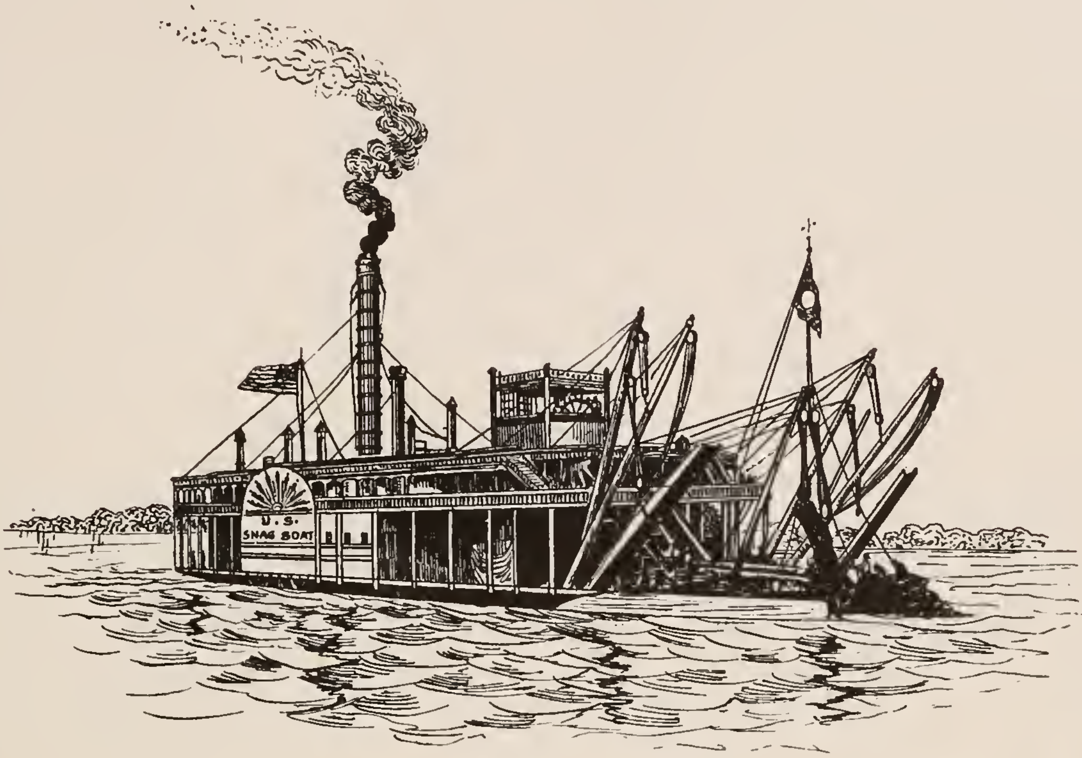
PENNSYLVANIA RAILROAD COMPANY—SPECIFICATIONS FOR A PERFECT SUBDIVISION.

1. Line.—The track must be in true line.

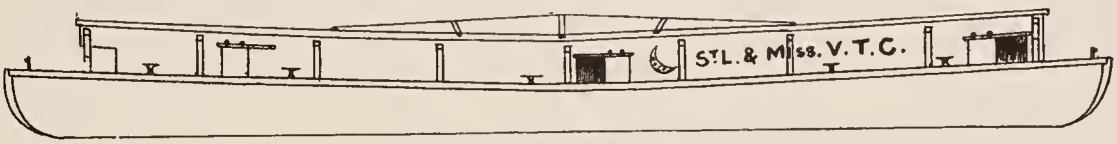
2. Surface.—The track must be in good surface; on straight lines the rails must be on the same level, and on curves the proper elevation must be given to the outer rail and carried uniformly around the curve. This elevation should be commenced from 50 to 200 feet back of the point of curvature, depending on the degree of the curve, and increased uniformly to the latter point, where the full elevation is attained. The same method should be adopted in leaving the curve.

3. Joints.—The joints of the rails must be exactly midway between the joint ties, and the joint on one line of rail must be opposite the centre of the rail on the other line of the same track. In winter a distance of five-sixteenths of an inch, and in summer one-sixteenth of an inch, must be left between the ends of the rails, to allow for expansion. The splices must be properly put on with the full number of bolts, nuts, and nut-locks, and the nuts screwed up tight. The rails must be spiked both on the inside and outside on each tie, on straight lines as well as on curves, and the spikes driven in such position as to keep the ties at right angles to the rails.

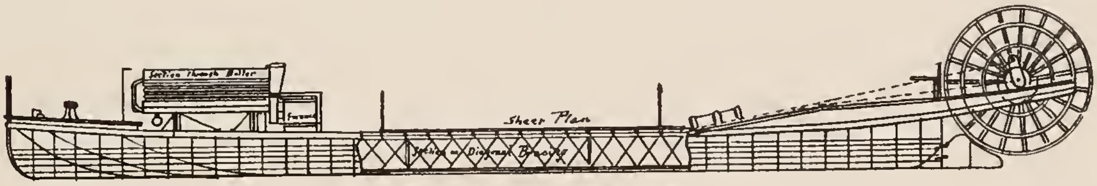
4. Ballast.—There must be a uniform depth of at least twelve inches clean, broken stone or gravel under the ties. The ballast must be filled up evenly between but not above tbe top of the ties, and also between the main tracks and sidings where stone ballast is used. In filling up between the tracks, coarse, large stones must be placed in the bottom in order to provide for



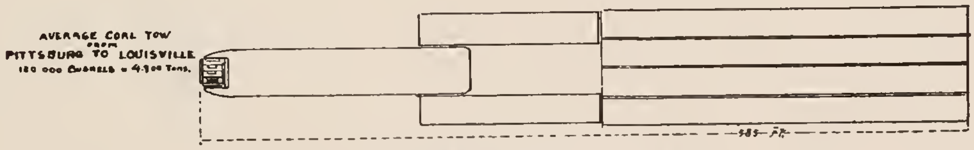
United States Snag-Boat.



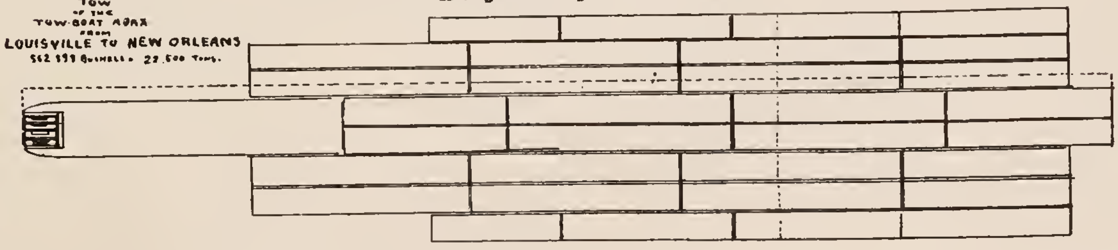
Western River Model Barge.



Western River Towing Boat.



Diagrams of Coal Tows.



drainage; but care should be taken to keep the coarse stone away from the ends of the ties. At the outer ends of the ties the ballast must be sloped off evenly to the sub-grade. When stone is used it must be broken evenly, and not larger than a cube that will pass through a two and one-half inch ring.

5. *Cross-ties.*—The cross-ties must be properly and evenly spaced, with ten inches between the edges of bearing surface at joints, with intermediate ties evenly spaced, and the ends on the outside on double track, and on the right-hand side going north or west on single track, lined up parallel with the rails. The ties must not be notched under any circumstances, but should they be twisted must be made true with the adze, that the rails may have an even bearing over the whole breadth of the tie. For main running tracks sixteen ties, for branch roads and third tracks on main lines used exclusively for freight trains fourteen ties, and for sidings and tracks used for standing cars only, not exceeding twelve ties are to be used for each thirty-foot rail. Supervisors and track foremen will be held strictly accountable for any deviation from these specifications.

6. *Switches.*—The switches and frogs must be kept well lined up and in good order. Switches must work easily, and safety blocks attached to every switch head where "stub" switches are used. Switch signals must be kept bright and in good order, and the high signal used for all switches where train runs against the points. Particular attention must be given to avoid low joints at the head blocks of switches. The standard distance between guard rail and main rail will be two inches.

7. *Sidings.*—All company sidings should be kept in as good order as practicable, using for this purpose second-class rails and ties, or partly worn material taken from main tracks. Owners of private sidings must be required to keep their sidings in safe condition for use at all times.

8. *Ditches.*—The cross-section of ditches at the highest point must be of the width and depth as shown on the standard drawing, and graded parallel with the track, so as to pass water freely during heavy rains, and thoroughly drain the road-bed. The line of the bottom of the ditch must be made parallel with the rails, and well and neatly defined, at a distance of not less than seven feet from the outside rail. All necessary cross-drains must be put in at proper intervals. Earth taken from ditches or elsewhere must be dumped over the banks, and not left at or near the ends of the ties, but distributed over the slope. Earth taken out of the ditches in cuts must not be thrown on the slope. The channels or streams for a considerable distance above the road should be examined, and brush, drift, and other obstructions removed. Ditches, culverts, and box drains should be cleared of all obstructions, and the outlets and inlets of the same kept open to allow a free flow of water at all times.

9. *Road Crossings.*—The road crossing planks must be securely spiked. The planking should be three-quarters of an inch below the top of rail, and two and one-half inches from the gauge line. The ends and inside edges should be beveled off.

10. *Station Grounds.*—Station platforms, fences, and grounds at stations must be kept clean and in good order.

11. *Policing.*—The telegraph poles must be kept in proper position, and trees near the telegraph line must be kept trimmed to prevent the branches touching the wires during high winds. All old material, such as old ties, old rails, chairs, car material, &c., must be gathered up at least once a week, and neatly piled at proper points. Briers and undergrowth on right of way must be kept cut close to the ground.

12. *Use of Materials.*—Proper judgment and caution must be exercised by engineers, supervisors, and foremen against extravagant use of materials, as they will be held strictly responsible for the same.

By order of general manager.

William H. Brown, Chief Engineer.

Office of Chief Engineer Pennsylvania Railroad Company, Philadelphia, June 1st, 1882.

GENERAL DIRECTION OF ROAD-BED IMPROVEMENTS.

The terse directions given above represent positive conclusions on a number of details about which differences of opinion formerly prevailed. They also illustrate, to a considerable extent, the important requirements relating to road-bed and track about which railway companies feel more or less solicitude, and fail, in varying degrees, to secure the highest standard of desired excellence on all parts of their lines.

An indication of what was progressing on various leading lines, in the matters under discussion during the latter part of the eighth decade is furnished by letters written by two road masters of the Atlantic and Great Western in March, 1879, to Charles Latimer, Esq., then chief engineer of that company, after they had journeyed over the lines to which they referred to attend a meeting of the road masters of the United States, held in Boston on March 25th, 1879, and published in Proceedings of the Road Masters of the Atlantic and Great Western. Their remarks show that at that time the ballast used on the Lake Shore was principally coarse sand, but locomotive cinder was used on portions of it; on the New York Central the ballast was principally locomotive cinder, sand, and gravel, and in some places coal slack mixed; on the Boston and Albany and Old Colony the ballast was generally sand; on the Erie the ballast was generally locomotive cinder. At a later date the Erie adopted a standard similar to that of the Pennsylvania, requiring the extensive use of stone ballast.

As an aid to effective drainage ditching is the principal adjunct of ballasting, the latter raising the road-bed to a high elevation and the former indirectly accomplishing a like end by deepening the surroundings, in avenues convenient for the passage of water. The old style of railroading often failed to make adequate provision for either ballasting or ditching, and at the present day, on many roads, one or both these labors are often neglected to a damaging extent. As an adjunct of drainage culverts are of great significance. In some sections of the country there are about two to each mile of railway. If deficient either in number, capacity, or condition, serious damage is likly to occur.

Another feature of a road-bed which requires constant attention is the cross-ties, which should be, and frequently are not, in proper condition and position. A number of varieties of wood is used, and different methods of preparing it are adopted, some being sawed instead of hewn, which is considered the best method. It has also been found advantageous to have the bark removed before ties are put in the track.

As a railroad is expected to be prepared for the movement of trains at all times, despite adverse action of elemental forces, much preparatory and cautionary work must be done, and it is not only desirable that the normal position of the road-bed should be as well fortified as possible against any probable damage from fierce storms, freshets, and sudden climatic changes, but it is necessary that all portions of the track exposed to injury should be frequently examined during the night as well as the day, so that timely notice can be given to advancing trains of all obstructions or dangerous imperfections. Such duties come within the province of those who are entrusted with the supervision of tracks, and the extent to which safety is assured largely depends upon their fidelity.

In no class of roads is it so essential that there should be a thoroughly good road-bed as in railroads. In the absence of a proper foundation, it is impossible to extract from a superstructure, no matter how high its characteristics may be, all or even a considerable proportion of the desirable qualities. A rail, whether of steel or iron, cannot be expected to meet modern requirements if it does not rest upon effective supports. This statement is so commonplace that an apology should be made for presenting it, if experience did not indicate that its significance had sometimes been ignored. Railways, like long rows of city houses, however, have been built for sale rather than for use, and they are frequently constructed in a manner known to be imperfect, on account of paucity of funds, in the hope and expectation that they will gradually be improved after earning power is attained. Such wide differences exist between the most defective and the most advanced lines of this country that the United States now has a large percentage of the best and worst railways of the world. Nowhere else have inventive genius and experimental effort done so much to improve a great variety of details, ranging through every ramification of permanent way and rolling stock, and nowhere else has an equally large mileage of defective roads been constructed.

The relative importance of labors, so far as it can be shown by the number of employés engaged in repairs of tracks, is indicated by the fact that out of 418,957 persons in railway service reported in the census of 1880, 122,489 are classed as track men, which was considerably more than the number engaged in any other specified railway pursuit.

TRACK GOODS AND TOOLS.

The list of articles for which premiums were offered by the Chicago Exposition of Railway Appliances, in 1883, under the head of Track Goods, embraced the following: Display of steel and iron rails and track goods; track-laying device; steel rail in section and finish, not less than 30 feet long, not less than 50 pounds to the yard; iron rail in section and finish, not less than 30 feet long, nor less than 50 pounds to yard; rail punch or drill; rail straightener; rail tongs; track bolt; track bolt washer; railway fencing; tamping bar; track chair; claw bar; cross-tie (metal); process for preserving wood cross-ties and timber; power excavator; frog; crossing; fish or angle plate; track jack; jack screw; track bolt and nut; track level; spike maul; nut lock; scraper; post hole auger; track gauge; outfit for track gang; cold saw machine for cutting steel or iron bars cold; shovel; spade; spikes (one keg); switch (upright, complete); switch (ground, complete); switch lock; switch stand; track broom; barrow; cart; pinch bar; wrecking frog; complete track joint; system of interlocking yard switches.

Under the head of miscellaneous, premiums were offered for the following articles: Iron bridge (working model or otherwise); wooden bridge (working model or otherwise); track signal (working model or otherwise); track signal (torpedo); crossing signal; safety gate for crossing; flange device to remove compact snow and ice from between the rails, and a proper space outside the track; automatic switch: switch signaling device; electric signaling device for block or other signals; snow plow.

RAIL-JOINTS AND RAILS.

ASIDE from their feature of greatest importance, which is the rail, tracks must be supplied with methods of fastening rails to the ties, and of guarding against the fatal effects of a lack of continuity of the great avenues of modern commerce. The rails cannot be placed so closely together that the ends would touch in cold weather, because if this was done the expansion caused by heat would damage the entire line, and this disaster has often occurred. The problem being to place the ends of the rails closely together, so as to form a continuous line, and yet not to permit them to touch each other, except when the highest temperature prevails,

EFFECTIVE RAIL-JOINTS OR SPLICES

of one kind or another must be provided, and the adjustment of this matter, which seems comparatively simple, has undergone a long series of experiments, the expedients ranging through various forms of chairs, fish-joints or plates, angle-bars or angle-bar joints, with a strong tendency favorable to the latter, because it affords additional strength, as compared with other devices.

The material required for one mile of single-track railroad, with rails of the usual length of 30 feet, embraces 704 splice-bars or fish-plates of one kind or another, or half that number of chairs, and unsatisfactory workings of any appliances that are so numerous, and intended to serve such important purposes, necessarily cause much inconvenience. This is aggravated by the fact that the joints are generally the weakest places in the track; it is there that the wear of rails is most serious; whatever may be defective there speedily grows worse. In attempting to provide for this requirement, if the rail is cut, drilled, or punched to an unusual extent, it sometimes suddenly breaks, and thus creates one of the greatest of track dangers. Although no device fully meets all requirements in a pre-eminenly satisfactory manner, great advances have been made, and the best of the modern arrangements represent a notable and important improvement.

Even angle-bars, however, frequently break, if they are subjected to unusually severe strains, arising from imperfections in the track, flat wheels, rough wheel flanges, or other causes, or if they are of relatively light weight and made of poor iron. An interesting paper on the question, "Why Do Rail-Joints and Splice-Bars Break?" was read before the Engineers' Society of western Pennsylvania, in January, 1885, by M. J. Becker. It states that he had "found 1,130 broken angle-bars on a single division of six miles of track."

One of the notable stages of progress was the extensive use, at one time, of fish-plates on one side of the rail and angle-bars on the other, a practice subsequently followed, to a considerable extent, by the use of angle-bars on both sides of the rail.

STEEL RAILS AND RAIL PATTERNS.

The rapid advancement of steel-rail-making industries in the United States, which typified the substitution of steel for iron rails on many of the older lines, and the general use of steel rails on new lines, has been referred to elsewhere. It was accompanied with considerable changes in the shape and weight of rails, and the introduction of many patterns representing minor modifications. In 1881 there were regularly manufactured in 11 Bessemer steel-rail mills of the United States 119 patterns of steel rails of 27 different weights per yard. The variations in shape are of comparatively small importance, nearly all approximating to a type known as the "Chanute" head or the Lehigh Valley Templet of 1872. The first of the American steel rails were generally made of patterns previously used in the manufacture of iron rails, which varied considerably, but were frequently of a type known as pear-headed, adopted for the purpose of preventing the sides of the head from breaking down, represented by the Buffalo, Corning and New York rail of 1857. Another type of iron rail, however, which had rendered excellent service was the old Reading rail of 45 pounds. It more nearly conformed to the original type of T-rail designed by Robert Stevens. With the introduction of steel rails, a material change of pattern became desirable on account of the differences in the metal, and for various reasons, one of which was that the superior strength of steel rendered it practicable to cut out the under side of the head, leaving a nearly flat table to hold a fish-plate, and so sustain and preserve the ends of the rail. The practical conclusions reached, after an elaborate consideration of this subject, are illustrated by diagrams representing 10 patterns of the different weights of 30, 35, 40, 50, 56, 60, 63, 65, 67, and 72 pounds per yard, which approximately represent modern American practice, and which were strongly urged for adoption for the purpose of saving to rail makers, and incidentally to railway companies, unnecessary expense, in an interesting paper on Rail Patterns, read by A. L. Holley, at a meeting of the American Institute of Mining Engineers, held in 1881, as a substitute for the numerous patterns then in use.

The general considerations which affected the adoption of the

PREVAILING SHAPES OF STEEL RAILS

are explained in the following extracts from Mr. Holley's paper, referred to above:—

"1st. A few years' use of steel abundantly proved that the sides of the head do not break down, even if quite thin. The only normal mechanical destruction is the wearing out. The occasional mashing of the ends, and the very rare splitting and crushing of the rail elsewhere, are due to the bad casting of ingots, and to working spongy ingot tops into rails. The breaking of rails which are properly laid, is due to chemical defects. The strength of steel thus rendered it practicable to cut out the underside of the head, leaving nearly a flat table to hold a fish-plate, and to sustain and preserve the ends of the rails.

2d. The next point was to decrease the normal destruction by wear. Breaking down did not occur, and lamination could not occur in the product of a fusion process. The first, and very obvious suggestion was to put as much metal as possible into the head, without robbing the web and flange, and impairing the rail as a beam. These points will be considered farther on.

Having as much metal as possible in the head, what proportions and shape endure best, reference also being had to the wear of the rolling stock? A wide head theoretically reduces the pressure per square inch, of the wheels. But on account of the slight coning of the wheels, it has been observed that their actual foot-prints are only three-quarters to one inch wide, while those wheel-treads which are worn hollow do not take a full bearing on a wide head. If the head is wide, it must be thin, with a given weight of rail, so that its side presents less surface and hence a higher rate of flange wear, and a greater variation in the gauge of the track. The heads must be wide enough to give ample bearing to the fish-plates, otherwise they are soon worn to such shape that they cannot be kept tight. Exactly the best width of head for a given weight of rail can hardly be determined, but the experience of a decade has convinced experts generally, that for 56- to 70-pound rails, it lies between 2¼ and 2½ inches. Rail designers have, therefore, respectively adopted every possible fraction of this undetermined quarter of an inch.

3d. The width and shape of the head having been provided for, how much metal can be spared from the web and flange to deepen it, and how shall the remaining metal be disposed? The rail is now to be considered as a beam, and as a bearing to transfer the vertical and lateral strains to the sleepers. It is obviously impossible to determine the exact proportions which are better than any others, because the conditions of use vary almost infinitely; but so nearly the best form for average use has been determined by practice, that no one can prove it not to be the best.

I. The web and base of the rail have been pared down to meet the conditions of the beam, until further reductions would impair their safety. . . . The width of base must be so great that the rail will not turn over, and not cut into the sleepers. . . . In the best American practice, with sleepers 2 feet apart centres, the base and height of rails are usually the same. A 4-inch base, with 4½-inch height, is the largest deviation from this rule.

II. The web of the steel rail has been pared down until it runs in the twenty-two 56-pound patterns, from 13 to 20 thirty-seconds, and in the thirty 60-pound patterns, from 7 to 10 sixteenths of an inch. But no web of any of the current patterns has broken down from being too thin. Whether or not a 64th should be added or removed, no man can say; nor is the question of farther variation of any importance.

III. The foregoing proportions having been settled, the question is: How much of the remaining metal shall go into height of web, and how much into thickness of head? To perfect the rail as a beam, so much of it should go into the web as to at least double the standard height, because the stiffness of the beam increases as the cube of the height. But it has been ascertained that with the best existing type of road-bed, 5½-inch rails wore out more rapidly than 4-inch rails of the same quality. The reason is obvious. The higher rails were too rigid. The lower rails yielded slightly under the load. Dr. Dudley graphically describes wear as the breaking or mashing of the infinitesimal teeth which form the surface of the rail. We may regard the wheel as a projectile, which breaks and mashes these teeth. Its destructive effect is as the square of its velocity. The elasticity of the rail increases the time of impact, and so decreases the power of the blow.

As the tread of the rail becomes a more and more perfect plane by means of better manufacture and road-bed, the stiffness of the rail may be increased, and no doubt will be increased to carry heavier loads per wheel. With good ballast of the present type, and sleepers 2 feet apart centres, it has been found that a well-proportioned rail of about 4½-inch height will carry the present loads of 5 or 6 tons per driving-wheel to the best advantage. The Great Western ∩-rail, still used, is the worst form for stiffness.

The rule for spacing sleepers in a country where they are comparatively cheap is to leave just as little space between them as will allow the convenient tamping of ballast. There is great convenience in the even number, 2 feet, and it cannot be proved that it is not as good as 2 feet and a quarter of an inch, which some rail tinker would no doubt have specified, if it had occurred to him.

Iron and steel sleepers, so largely used in Germany and elsewhere, and especially the longitudinal system, will no doubt modify our permanent way in all departments at a no distant day, but we shall have time to enjoy any improvement of our present system.

Having thus determined all the proportions except the thickness of the head, we find rails of 60 to 72 pounds per yard may have heads of 1¼- to 1½-inch mean thickness, which will last, under average traffic, until new conditions of road-bed, load, and manufacture shall have indicated farther improvements in the weight and proportions of steel rails. It probably would not pay, considering the interest account and probable improvements, to secure longer wearing capacity, except in rails for specially severe service."

SWITCHES AND SIGNALS.

AFTER a railway is furnished with the indispensable appliances to which brief reference has been made, including road-bed, ties, rails, and rail-joints, the work of supplying all the requirements ot modern lines is still far from furnished. In an important sense it may be said that it has only fairly commenced. Even if the main line contains but one track, as is the case with a large proportion of the existing mileage of American roads, there must be sidings and switches. As business increases a considerable number of sidings and double-tracking, on an extensive scale, become necessary; the demands for stations, depots, improvements of bridges, signals, shops, and shop appliances multiply rapidly; the necessity for making large outlays for terminal facilities becomes urgent. The original cost of the main line of a number of the older roads has been more than duplicated by several classes of supplementary expenses, the largest being for bridges, stations, terminal facilities, and rolling stock. During the eighth decade, and since 1880, enormous sums were expended in the directions indicated, and a large proportion of the outlays were applied to improvements that greatly increased the practical efficiency of American railways. The work of advancing the condition of many of the older lines goes on incessantly, subject to fluctuations similar to those which occur in the progress of new construction, and a very large amount of capital is required for this purpose.

Meanwhile each feature is, in itself, improved. The station accommodations of one period are found to be inadequate at a later date; the favorite switch of one era is considered inferior to a new device; in the whole range of signal appliances there has been a remarkable advance, not only in the number used but in their mechanical characteristics; and the cost of the terminal facilities now existing represents as large an aggregate as the cost of the entire railway system of the country a few decades ago, or long after it had passed through its infantile stages. Comments are frequently made upon the rapid increase of the capitalization of the older lines which fail to give due credit for the extent to which useful ends were served by many of the additional outlays, and for the multiplicity of purposes to which they were applied.

SWITCHES AND FROGS.

Many accidents have been caused by the switch originally used on American railroads, and still used extensively on many lines, known as the stub-switch, or rather by the neglect to use all the precautions necessary to render it a safe device. Through carelessness it has exposed many thousands of trains to the danger of running off tracks, often caused great loss of property, and not unfrequently loss of life. In conjunction with switches frogs are used at the points where one rail crosses another, and a considerable number of improvements in both these appliances were devised and extensively introduced. Originally the frog was frequently made of rails, at a later date it was generally made of cast iron, but subsequently steel frogs were found to be much more durable and reliable, and there were improvements of patterns as well as of material. One of the new switches avoided altogether any breaking of the track of the main line, which was the great cause of switch accidents; others kept one track unbroken, and all diminished, to a considerable extent, the dangers arising from carelessness on the part of switch tenders or imperfect mechanism, as compared with the primitive stub-switch. As traffic increased, especially at terminal points, where many trains passed in and out of stations daily, requiring a large number of switch movements, some of the most complicated of modern railway mechanism was invented for the purpose of dispensing with numerous switch-tenders and rendering a large number of rapid movements from one set of tracks to other tracks safe. Effective signals are extensively interwoven with these devices, and the highest modern combinations of switches, switch-stands, frogs, signals, signal towers, and interlocking levers or machines, represent very notable and ingenious advances, as they enable hundreds of trains to daily make movements in a limited space with a degree of freedom that would formerly have been considered unattainable, and at the same time make the best possible provision for safety, by contrivances that cannot be operated in a manner that will cause serious damage no matter how much operators may blunder.

SIGNALS.

There have been and continue to be considerable variations in the shapes and patterns of signals with a tendency towards a preference for the semaphore on account of its natural effect in arresting attention, due to its resemblance to an outstretched arm when it is so set as to give a warning of danger, while when safety is indicated the arm is dropped. Various other forms are extensively used, some of which revolve in a manner that gives, at the will of the operator, such information as he wishes to convey. Many of the signals are intended for use at night as well as by day, and much ingenuity has been displayed in arranging lamps with sides of various colors, to perform the necessary service, red being a sign of danger, green usually of caution, and white of safety.

INTERLOCKING OF SWITCHES AND SIGNALS.

A catalogue, issued by the Union Switch and Signal Company in 1883, says: "The complete system of operating railway switches and signals by interlocking apparatus has been reached by successive steps, the gradual development covering many years. The first step was probably the combination of the stub-switch and target, still extensively used, the target standing perpendicular to indicate 'main track clear,' and inclined for 'side track clear.'

The second step, a combination of the stub-switch and revolving red and white target, coupled with red and white lights moving simultaneously with the switch.

The third step, the removal of the target and light to a distance from the switch, and operating the two separately, first the target, then the switch, either of which could be moved independently of the other, and thus the operator could break the main track without first setting the danger signal, which cannot be withdrawn while the switch is on the side track.

The last principle is the present basis of interlocking systems. The switches and signals of a junction, crossing, drawbridge, terminus, or other dangerous points, are controlled by a single operator from a cabin. In this are placed the levers, set in a cast-iron frame, by which the whole system of signals and switches is operated.

By the peculiar mechanism of this locking apparatus the levers are so interlocked with each other that the switches must be properly set and locked before it is possible to move the corresponding signal levers, and the different signals are so interlocked as to protect the path of a signaled train until it has passed the danger point. In brief the pith of the system consists:—

1st. In concentrating as many signal and switch levers together as can be worked conveniently from one station.

2d. The switches and signals of any danger point, however complicated, are connected in such a way that it is mechanically impossible that the position of the switches should ever be contradictory to that of the signals, or that incompatible signals should be given.

No matter how complicated the junction may be, if there are twenty, one hundred, or any number of levers brought together in a signal cabin, there is no possibility of the signal man making a mistake.

This is illustrated in the words of Mr. J. W. Barry, in his excellent work on Railway Appliances. He says: 'If a man were to go blindfolded into a signal-box with an interlocking apparatus, he might so far as accordance between points and signals is concerned, be allowed with safety to pull over any lever at random. He might doubtless delay the traffic, because he might not know which signal to lower for a particular train, but he could not lower such a signal or produce such a combination or position of points and signals as would, if the signals were obeyed, produce a collision.'"

SIGNALS FOR THE GENERAL PROTECTION OF LINE.

Aside from the use of signals at or near switches and at terminal stations, extensive advances have been made by a number of companies in the adoption of devices for the protection of lines from the dangers arising at crossings of highways, on tracks over which many trains pass at varying rates of speed, at way stations, or from breaking of rails or land-slides. It is evident that, in addition to the watchfulness of employés, systematic arrangements should be made, as far as possible, for giving timely warning of any probable or possible danger arising from overcrowding or derangement of tracks, and a variety of devices were invented, and to a considerable extent applied, for the accomplishment of this object. Electrical forces are generally used as an agent, and through their aid it is claimed that timely notice of any disturbing influence on a track, such as would be caused by a broken rail, can be given to the engineer of an advancing train through signals; that crossings can be protected; that the proximity of trains can be announced at stations, and that trains can be prevented from following so closely in the wake of each other as to create a danger of rear collisions. Most of these devices are substitutes, more or less complete, for the block system, being in most respects inferior, although it is claimed that in some particulars, especially in giving notice of broken rails, in reduction of expense, and avoidance of reliance on uncertain human agencies, they are superior.

THE BLOCK SYSTEM.

A method of guarding against accidents by preventing trains from following each other too closely, which resembles the English block system, was applied to the main line of the United Railroads of New Jersey before 1870. The following description of it is condensed from a statement made by T. L. Pope, to the Massachusetts railroad commissioners, dated January 22d, 1872:—

"The running of all trains on the main line of railroad between New York and Philadelphia is controlled by a series of safety signals operated in connection with a telegraph line employed exclusively for this purpose.

The system is arranged, in general terms, as follows: Telegraphic signal stations are established along the line at distances apart corresponding to the shortest interval that is permitted by the regulations of the road between any two trains going in the same direction. The engineer of each train, upon passing one of these stations, is informed by means of the proper signal if the preceding train going in the same direction has passed the next signal station in advance. In the absence of a signal denoting that such is the case, the train is required to stop and receive explanations, and is either detained until the preceding one has been heard from, or else is followed, by orders from the proper authority, to proceed on its way, using all necessary precaution, and expecting to overtake a disabled train.

On the New York and Philadelphia Railroad there are thirteen signal stations between the northern terminus of the road, at Jersey City and New Brunswick, a distance of thirty-one miles. This portion of the road is, therefore, divided into fourteen sections, averaging but a little over two miles each. As a matter of fact, none of them are more than three miles.

The number of regular trains which leave Jersey City during each twenty-four hours is forty, and the number arriving is the same. Of these, twenty run to and from New Brunswick and points beyond, and the remainder are local trains for the accommodation of the citizens of Newark, Elizabeth, and other intermediate points. With a single exception, none of these trains leave Jersey City at a less interval than ten minutes apart, this exception being a slow way train leaving four minutes behind an express train.

Between New Brunswick and West Philadelphia, a distance of 58.25 miles, there are twelve signal stations, averaging about four and a half miles apart. There are on this portion of the road seventeen regular trains each way daily between New Brunswick and Trenton (twenty-six miles), and twenty-four between Trenton and Philadelphia.

In passing over certain portions of the road in the cities of New Brunswick, Elizabeth, Newark, and Jersey City, the movements of the trains are not under the control of safety signals. All engines or trains going in either direction are obliged by the regulations to run with caution at these places, so as under no circumstances to endanger a preceding train. These portions of the track are much occupied with branch-trains, shifting engines, crossings of other roads, &c., &c., which makes it necessary to except them from the general system.

The signal employed is a white board, or a white light at night, shown through an orifice two feet in diameter, in a black signal box, and placed in a conspicuous position at the side of or directly over the track, so that it can be seen as far as possible. A partition within the box separates the signals for the opposite directions. A screen of red cloth covers the orifice in the box when the signal is in its normal position, concealing the white board by day or coloring the light red by night. The safety signal is exhibited to an approaching train by the telegraph operator, who pulls a cord attached to it, and terminating in his office, which lifts the red screen, and exhibits the white board or light. The moment the engine passes he lets go the cord, and the red screen again drops into its normal position by the action of gravity, concealing the white safety signal.

When within half a mile of a signal station, each approaching train gives a long, loud whistle. On hearing this, the operator at the station at once exhibits the white signal, providing that all preceding trains have passed the next station in advance, and he knows of no other obstruction.

If the white signal is not shown, the train is stopped in order to obtain information from the operator in regard to preceding trains which have not passed the next station, or of any other obstruction.

In case the train is allowed by the train dispatcher or other authorized person to proceed without the safety signal, and without knowing where the preceding train is, the engineer is required to look out carefully for obstructions, and keep his train perfectly under control till he reaches the next signal station.

When a train has passed a signal station, the time of passing is at once reported back to the last signal station and forward to the next one in advance, as well as to the principal office at Trenton or Jersey City, as the case may be. No operator is permitted to report a train as passed unless he has seen the red flag or light at the rear of the train, in order to be sure that no cars have been uncoupled and left on the track in the way of a following train. When this does happen, he reports the fact to headquarters and the proper telegraphic instructions are issued to provide for the case.

Trains passing a signal station, and which have not come from nor passed the preceding station—for instance, when coming in from a branch road—are required to notify the operator of that fact, so that he will not report it back, and cause a risk of its being mistaken for another train which may have passed the preceding station. When a train is to stop or leave the main line between two signal stations, it is required to report that fact to the last station it passes. In this case the operator does not show the white signal, but explains the circumstances to the next succeeding train. . . .

The system of controlling trains by telegraph and signals, which has been described, does not dispense with nor supersede any of the precautions previously in use, or which are used on roads not provided with such a system. A train stopped or delayed on the main track is not permitted to depend upon the station signal to hold the succeeding train, but is required to send back a warning signal at once. Thus it would seem that only by the grossest negligence or disobedience of positive orders on the part of two distinct persons simultaneously, is any collision liable to take place. . . .

It will be noticed that on this road safety signals are relied on to control trains, and not danger signals. In other words, where there is any liability to interruption or obstruction, such as drawbridges, crossings at grade, &c., the thing is presumed to be wrong until the engineer has positive evidence that it is right. If, on the contrary, a danger signal is relied on, and if, either from defect in the apparatus, or negligence on the part of the signal man or engineer, or if from fog, smoke, or any other cause, the danger signal, if made, is not seen, the result may be a terrible disaster. When a safety signal is depended upon, then if it is not made or not seen, the most serious result that will follow is an unnecessary stoppage of the train."

A similar system, intermingled with sundry modifications, was established a few years later on the main line of the Pennsylvania Railroad, and a few other roads.

BRIDGES AND CULVERTS.

THE portion of a railway ordinarily devoted to bridges, culverts, and trestle-work probably forms not far from 1 per cent. of its entire mileage, and on account of the expense of such structures, and their liability to injuries or deterioration of various kinds, which lead to fearful accidents, they frequently cause great anxiety.

The civil engineer of one of the prominent north-western roads recently stated that there were about two culverts to each mile of its main line, and if this average holds good everywhere there are now about 260,000 such structures in the United States, in addition to many thousands of bridges and a large amount of trestle-work. The difficulty of maintenance is materially heightened by a variety of considerations, such as uncertainty in regard to the possible volume of floods at the time of original construction, the financial necessity of reducing cost to the lowest possible limits consistent with safety, notable transitions from one set of plans and materials to others, the frequent erection of new bridges on old bridge sites under conditions that do not permit a serious interruption of train movements, and the rapid growth of traffic, accompanied with the substitution of heavy for light cars and locomotives.

Unless enormous outlays are made, and constant vigilance is exercised, special dangers lurk in every point of a line which is not based on solid earth. The simplest culvert may prove the scene and incidental cause of a dreadful calamity, if it furnishes an inadequate channel for gathering waters during an unusual freshet, or if it gives way at a critical moment. In the course of years all sorts of disasters, including a number in which scores of lives were lost, have happened at important and unimportant bridges. Late tendencies have been rather towards disasters at the latter class of structures; frequently on account of comparative neglect; but in view of the vast number of bridges and culverts in the country; the extent to which wide and deep streams have been crossed; the variety of new designs rapidly introduced; and the wonderful increase in the weight of trains, it is a matter of surprise and congratulation that fatal accidents are not much more frequent.

WOODEN BRIDGES.

Notwithstanding numerous great improvements a large number of the wooden bridges originally erected have not been replaced, the tendency on many roads over which the amount of traffic is not unusually large being to repair and strengthen as long as safety can be secured by such expedients, while on portions of lines on which an immense amount of business is transacted new bridges have frequently been erected. Even a considerable number of the new bridges of comparatively late date have wooden superstructures. In connection with this subject, as of various other topics connected with railway improvements, it should constantly be borne in mind that important changes are usually made slowly and gradually, and on portions of lines rather than their entire length, from the necessities of the case, a desire to utilize old structures and devices as long as possible, and economic or financial considerations. Some of the earliest of the wooden railway bridges were in use after the ninth decade was well advanced, and the number of wooden bridges now (1887) in existence probably greatly exceeds all other descriptions. This view is justified by statistics furnished in reports of state railway commissions. Of seventeen railways in Illinois it is reported that they have 268 iron and stone bridges and 5,605 wooden bridges; on nineteen railways in New York there are 1,633 iron and stone bridges and 3,563 wooden bridges; on the railways of Michigan there are 107 iron and stone bridges and 705 wooden bridges; on the railways of Iowa there are 108 iron and stone bridges and 12,000 wooden bridges. The figures given above for several states do not include trestles, which are generally of wood. Of the structures of an important road in Iowa it was recently reported that they embraced 47 wooden truss bridges, 1,287 wooden trestle and pile bridges, 31 iron bridges, 7 iron trestles, 2,331 cattle guards, 1,250 timber box culverts, and 444 stone box culverts. The proportion of iron or stone structures is much greater on roads of some sections.

RAPID ADVANCES IN THE ART OF BRIDGE BUILDING.

Of the state of the art of iron bridge building in the United States about 1865 a distinguished engineer said in 1877 that "none of the roads centreing in New York had substituted iron for wood. The Pennsylvania Railroad, almost alone in that state, was but in the infancy of the effort which has since resulted in securing to her use some of the finest specimens of bridge architecture in the world. In the west a few scattering efforts had been made, and the subject was beginning to attract the attention of some of the best minds of the country. Squire Whipple, Albert Fink, Shaler Smith, Jacob H. Linville, and Thomas C. Clark had built bridges at that time, it is true, but such names could almost be counted upon the fingers, and even these would, perhaps, now admit that they then 'builded better than they knew.'"

As skill in bridge building increases, and the cost of construction diminishes, or available capital grows more abundant, new undertakings are commenced and prosecuted to a successful conclusion which would scarcely have been seriously considered at earlier periods. This tendency is illustrated not only by a notable increase in the number of important bridges erected, but by the location of such structures at points nearer the mouth of large rivers from year to year. After the possibility of bridging the Upper Mississippi was demonstrated, it required years of effort before a bridge was constructed at St. Louis, and since its erection laws have been passed authorizing the construction of bridges at Memphis and Vicksburg. To bridge the Ohio at Wheeling was formerly considered quite an achievement. Subsequently bridges were erected at Cincinnati and Louisville, and now (1887) a railway bridge near its mouth at Cairo is reported to be in course of erection by the Illinois Central. Schemes for bridging the Hudson have been under consideration for years, but it was not before 1887 that the speedy completion of a structure at a point as near its mouth as Poughkeepsie was assured. Similar progress towards the erection of bridges at points nearer and nearer the mouth of other great rivers has been made in nearly all sections of the country.

Since 1865 few things have advanced more rapidly in the United States than the art of bridge building. One of the notable tendencies has been towards the substitution of iron for wood, followed by an extensive substitution of steel for iron, and at a later date by a proclivity, in some directions, towards the erection of stone bridges wherever they were practicable. Intermingled with these changes there have been many important modifications or inventions of designs, and an increasing disposition to entrust the work of building important bridges chiefly to bridge building firms or companies. A number of the latter have been formed, each of which, to a considerable extent, controls special designs. They have gained extensive reputations for the cheapness and reliability of the structures they erect, and on account of facilities and skill acquired by special attention to this important industry their services are so frequently required, that the general practice is now to have bridges built by them, instead of by railway companies.

After the desirability of numerous high and lengthy railway bridges over navigable streams became evident, strenuous efforts were made to secure appropriate superstructures of a material more durable and less inflammable than wood, at a moderate cost, as compared with the prices commonly paid in England and on the continent. Great ingenuity in the direction indicated was rewarded by extraordinary success.

The details of these advances are so complex that they can scarcely be understood by non-professional readers. Like sundry other things connected with transportation they represent some of the highest achievements of applied science. A good general description of the salient features and leading characteristics of

AMERICAN IRON RAILWAY BRIDGES

as they were constructed in 1876, and to a large extent since, is furnished in the following extract from a paper on this subject read by Thomas C. Clarke, M. I. C. E., before the American Institute of Mining Engineers, in Philadelphia, during the centennial year:—

"Some philosopher has said that *results* come from internal impulses modified by external conditions. Applying this to European bridges, we find that the internal impulse is, *first*, to make as strong and as safe and as durable a structure as possible, and that the question of cost holds a secondary place. The external conditions are plenty of time and rivers of comparatively uniform regimen, so that there is but little danger of scaffolding being washed out by floods during erection.

Hence we find, consecutively, stone arches, cast-iron arches, plate girders, and, finally, lattice girders of plates and angles riveted together, copying the proportions already established for plate girders.

In this country, on the other hand, the internal impulse is to build the bridge, and in fact everything else, in as short a time as possible, and for the least possible sum. Hence our railway bridges were originally made of the most abundant and cheapest material, wood, and so designed as to be put together with the utmost rapidity, inasmuch as our rivers are subject to sudden and heavy freshets, and it never is safe to trust the bridge long supported by staging which may be washed out in a night. Hence when we began to build our iron bridges we copied the proportions already established as most economical in wooden trusses, and instead of riveting the several parts together on the scaffolds, we adopted the use of tenons and sliding joints for the compressive members, and of pins and eye bars for those in tension, which enables us to erect our bridges, without fitting, very rapidly.

Having begun in this path, we have seen no reason to depart from it. We find that great economy of material, which simply means little dead weight, is got by concentrating the iron along the lines of strain, by making long panels, which means few parts, and by proportioning our girders of a depth of never less and often more than one-eighth of their span. The form of truss now almost universally adopted, and which, by a process of natural selection, has almost driven out of use the Bollman, Fink, and triangular girders, is the quadrangular girder with vertical posts, and main tie bars inclined at an angle as nearly 45 degrees as possible. This has the merit of subjecting the iron to strains in one direction only, either tension or compression; and if we agree with Herr Wöhler that iron strained both ways is as highly strained as if the tension and compression were added together, this is a point of no small importance. We prefer to hang our cross-floor beams from the pin, because then the load is transferred directly by the diagonal tie bars without any bending moment.

Our peculiar web system allows us to give great height to our trusses, sufficient to enable us to put in vertical transverse bracing high enough to clear the smoke-stacks of the locomotives, which, we think, adds much to the lateral stiffness of our bridges.

THE USUAL PRACTICE OF AMERICAN ENGINEERS

is to provide, in addition to the weight of the structure itself, for a general rolling load of 4,000 pounds per foot for spans of 50 feet and below; 50 feet to 100 feet 3,000 pounds; 100 feet to 150 feet 2,750 pounds; 150 feet to 250 feet 2,500 pounds; 250 feet to 300 feet 2,250 pounds; above 300 feet 2,000 pounds. In addition to this, the floor and panel system is strengthened to provide for a load arising from the concentrated weight of the engine of 3,500 pounds and sometimes 4,000 pounds per foot lineal. Strains in tension are taken at 10,000 pounds per square inch; and in compressions 8,000 pounds to 10,000 pounds for chords of 10 to 14 diameters, and 4,000 pounds to 6,000 pounds for posts of 20 to 30 diameters.

So much for the designs of our bridges. When we come to examine the methods of construction, we shall see that the marked feature is the use of special machine tools, by which the sizes and lengths of all the parts are fitted with the utmost exactness at the place of manufacture. The ends of the upper chords and of the columns are faced in lathes; and the lower chord bars and diagonal tie bars are drilled with a pair of drills set on a wrought-iron bed, so as to give absolute accuracy of length. The pins are turned, and fill the holes so well that $\frac{1}{100}$th of an inch is the limit of play allowed.

Now the point to which I particularly wish to call your attention is that when once the machinery is provided this accuracy of workmanship costs nothing. Hence there can be no disposition to slight work, and make imperfect joints and bearings. The process of manufacture is the best inspection possible. The bridge is calculated to come to a certain camber, and if it does not come to that camber, or if any of the eye bars are loose, something is wrong.

Now every one who has ever built riveted lattice bridges knows that unless iron templates are used, and the greatest possible care taken in laying out the work, that the rivet holes will not come opposite to each other, and either drifting or riming must be allowed. Exactness of workmanship *can* be attained, but it costs the maker a great deal more money than rough fitting, while in the machine-made bridges there is no inducement to do poor work.

As to the actual economy of material, perhaps the best illustration that I can give you is to quote the weights of the 200-foot spans over the Miramachi river, on the Intercolonial Railway, of Canada. Tenders were received for these bridges from various European, English, and American bridge builders. There were 17 spans of uniform length, and these were all designed on the same specification, viz., to carry a general moving load of 2,800 pounds per lineal foot, and a load on floor system of 3,600 pounds per foot; strains in tensions, 10,000 pounds per square inch; in compression, in chords, 7,500 pounds to 8,000 pounds per square inch, or posts 4,000 pounds to 6,000 pounds.

The different designs may be divided, for purposes of comparison, into four classes: 1. Riveted lattice girders, short panels, 6 feet to 8 feet long; low trusses 16 feet to 18 feet high; weights 244½, 221, 206½, 202 tons. 2. Riveted lattice girders, panels, 9 feet to 10½ feet long; trusses 20 feet high; weights 141, 140, 137, 144½ tons. 3. Pin connected trusses, panels, 9 feet to 11 feet; trusses 20 feet to 22 feet; weights 128½, 126½, 122 tons. 4. Pin connected trusses, panels, 12 feet to 14 feet long; trusses 25 feet to 28 feet high; weights 111, 109½, 102 tons. It will be observed that the saving of dead weight is due more to the design than to the difference between riveted and pin connections. We may say roughly that the difference due to this cause alone is nothing for spans of under 100 feet; from 100 feet to 200 feet 5 to 20 per cent. Above 200 feet the increase is rapid in favor of pin connections. When we come to examine the question of rapidity of erection, the pin connections have a great advantage. They can not only be built much quicker, but they require no skilled labor; any ordinarily intelligent laborers can erect them, under a good foreman. Those of my hearers who have had the opening of their lines delayed by a strike of the riveters can appreciate this point.

Spans up to 150 feet can be erected by a gang of 20 men in a single day, if necessary; a 200 foot span, 2 to 3 days; a 250 feet, 3 to 4 days, &c.

As we put a less quantity of iron in our bridges, we are able to use a better quality. In fact it is difficult to make the eye bars, forged by hydraulic pressure, except out of a good quality of iron.

AMERICAN AND EUROPEAN METHODS CONTRASTED.

One more point, and I have done. In Europe I believe that the practice is to receive tenders by the pound upon detailed drawings.

In the United States the engineer makes a general specification, giving the lengths of spans, width, angle of skew, if any, the loads the bridge must be designed to carry, and the limit of allowed strains, leaving all details of construction and arrangement of depth, length of panels, &c., to be determined by those competing. Different engineers, either connected with bridge establishments or acting independently, but all following that branch as a specialty, make plans in accordance with the specifications, and tender so much per foot or span, keeping the weights to themselves. These methods have their advantages and corresponding disadvantages.

The European method, while securing plenty of iron and safety in construction, has overloaded its bridges with dead weight, and made very long spans unattainable except at great cost, from there being no competition in design. The American method has up to this time secured both a safe and an economical use of material, and good quality of iron and workmanship. This has been due directly to competition in design.

ECONOMIZING MATERIAL.

But, as prices fall, the tendency is to economize material too much, particularly in short spans, which ought relatively to be stronger than long spans, which are strained chiefly by dead loads. The next step will be to use an inferior quality of iron, unless this is prevented by rigid inspection, or, as in the buying of locomotives, purchasers trust in a great measure to the reputation of the large establishments, which is too valuable to be sacrificed for a few tons of iron. Where this guarantee is not attended to, as in the case of county road bridges, which are almost always let to the lowest bidder, entirely irrespective of skill or reputation, the most disastrous results follow. If a county road bridge will stand up until it is paid for it is considered a good bridge. It is said that the elephants who travel with menageries, when they encounter an iron road bridge, cannot be prevailed upon to even try to cross it. A wooden bridge they will condescend to examine, and if it seems firm, they will sometimes go over it. But when they see an iron bridge they take for the river, and argument is in vain.'

GENERAL SPECIFICATIONS FOR IRON BRIDGES

to be built on the New York, Lake Erie and Western, issued by that company in 1879, state that the following modes will be preferred, viz.: Spans up to 17 feet, rolled beams; spans 17 to 40 feet; spans 40 to 75 feet, riveted lattice girders; spans over 75 feet, pin-connected trusses.

The bridges were required to be proportioned to carry the following loads:—

1. The weight of iron in the structure.

2. A floor weighing 400 pounds per lineal foot of track, to consist of rails, ties, and guard timbers only.

These two items, taken together, shall constitute the "dead load."

3. A moving load for each track, supposed to be moving in either direction, and consisting of two consolidation engines coupled, followed by a train weighing 2,240 pounds per running foot.

A clause required that "the maximum strains due to all positions of the above 'live load' and of the 'dead load' shall be taken to proportion all the parts of structure.' Other specifications required that provision should be made for wind strains and vibrations, for variations in temperature, and that there should be strict compliance with a large number of directions relating to details of construction and other subjects.

The accidents which occur at bridges, through their giving way at a time when a passenger train is passing over them, sometimes cause such a terrible loss of life that they awaken national interest, elicit general discussions and elaborate investigations, which are sometimes followed with legislation or regulations of railway commissions and companies relating to methods of erection and inspection.

One of the disasters which caused more than the usual amount of agitation, on account of great loss of life, was the failure of the Ashtabula bridge in December, 1876. It was an iron bridge erected in the autumn of 1863, and after having been used for more than a dozen years it suddenly gave way during a blinding snow storm. A committee of the Ohio legislature and a number of civil engineers investigated the causes of the accident and the report, in which three civil engineers concurred, concludes as follows: "We find nothing in this case to justify the popular apprehension that there may be some inherent defect in iron as a material for bridges. The failure was not due to any defective quality in the iron. It was not owing to the sudden effect of intense cold, for failure occurred by bending, and not by breaking. It was not the result of a weakness gradually developed after the erection of the bridge. It was due simply to the fact that it was not constructed in accordance with certain well-established engineering principles. We find no evidence of any weakness which could not have been discovered in the plan and avoided in the construction."

The fact that this bridge, notwithstanding these defects, had proved serviceable during a protracted period, directed attention to the desirability of improved methods of inspection and repair, as well as of construction, and the nature of the conclusions reached, and of the character of the precautions that were deemed necessary, are indicated by the following extracts from a bill to secure greater safety for public travel over bridges, the passage of which was recommended by a joint Senate and House committee of the Ohio legislature:—

Section 1. *Be it enacted by the General Assembly of the State of Ohio,* That all railroad bridges hereafter erected and designed or used for public travel, excepting those provided for in section seventeen of this act (relating to narrow-gauge railways), shall be built to carry, for usual loads, not less than the following, in addition to their own weight, namely: Bridges having a span of 8½ feet and under, 9,000 pounds per lineal foot for each track; those having a span of 7½ to 10 feet, 7,500 pounds per lineal foot for each track; those having a span from 10 to 12½ feet, 6,700 pounds per lineal foot for each track; those having a span from 12½ to 15 feet, 6,000 pounds per lineal foot for each track; those having a span from 15 to 20 feet, 5,000 pounds per lineal foot for each track; those having a span from 20 to 30 feet, 4,300 pounds per lineal foot for each track; those having a span from 30 to 40 feet, 3,700 pounds per lineal foot for each track; those having a span from 40 to 50 feet, 3,300 pounds per lineal foot for each track; those having a span from 50 to 75 feet, 3,200 pounds per lineal foot for each track; those having a span from 75 to 100 feet, 3,100 pounds per lineal foot for each track; those having a span from 100 to 150 feet, 3,000 pounds per lineal foot for each track; those having a span from 150 to 200 feet, 2,900 pounds per lineal foot for each track; those having a span from 200 to 300 feet, 2,800 pounds per lineal foot for each track; those having a span from 300 to 400 feet, 2,700 pounds per lineal foot for each track; those having a span from 400 to 500 feet, 2,500 pounds per lineal foot for each track; and in all bridge trusses of whatever length the several members in each panel shall be so proportioned as to sustain, in addition to its share of the uniform load as above stated, such concentrated panel load as is herein provided for a bridge of a length equal to the length of the panel.

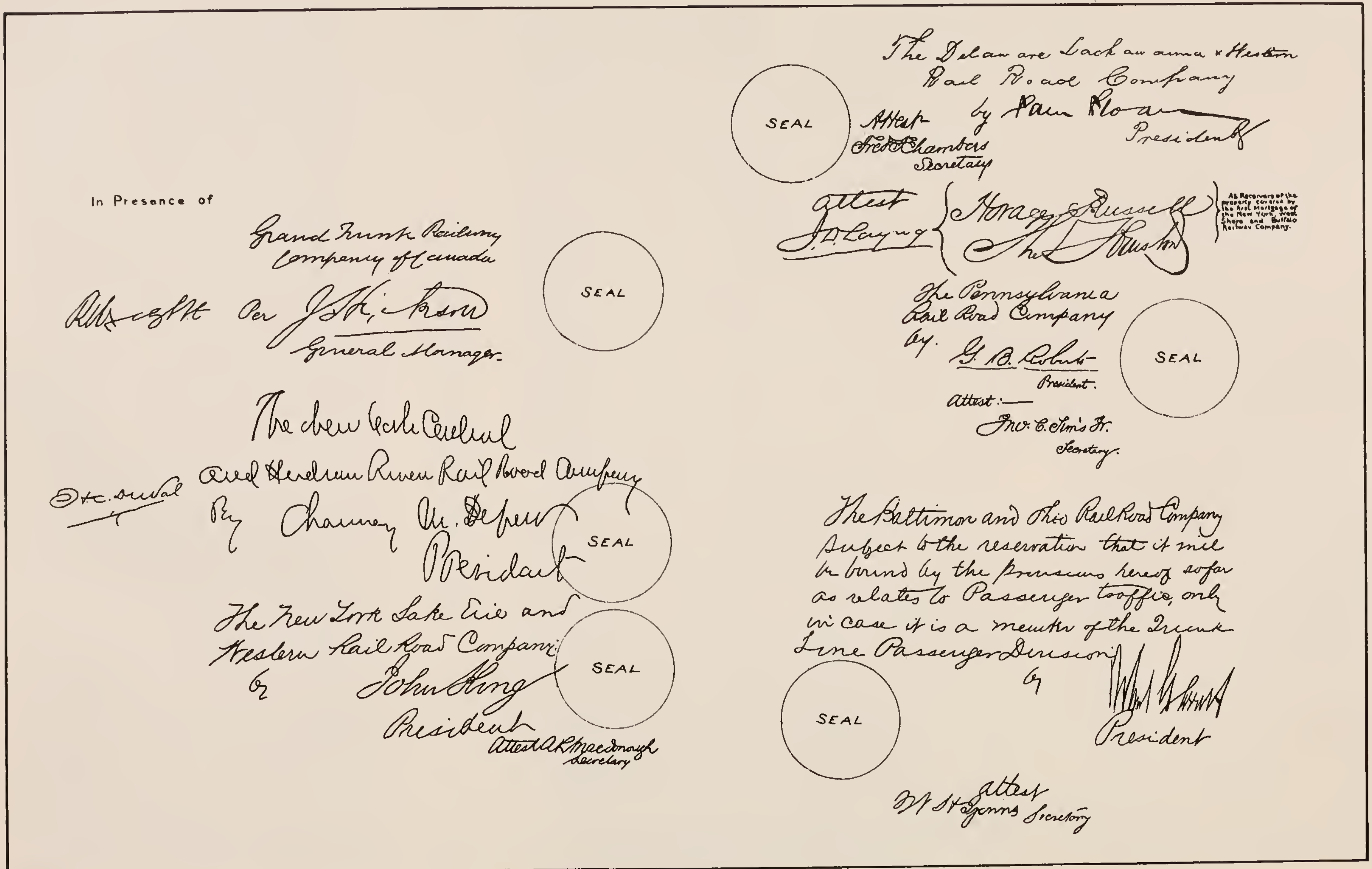
Sec. 2. Every railroad bridge shall be so constructed as to be capable of carrying on each track, in addition to its own weight, two locomotives coupled together, each weighing 91,200 pounds, on drivers, in a space of 12½ feet for each locomotive, and said locomotives to be followed by cars weighing 2,250 pounds per lineal foot, covering the remainder of the span; and all railroad bridges shall be so projected that the loads above mentioned in section one shall not strain any part of the material in such structure beyond one-fifth its ultimate strength. . . .

Sec. 4. In the construction of all bridges for public travel, either for railways or common wagon ways, the stress on any material used in the construction of the bridge, in carrying the maximum load for which such bridge is designed, shall not exceed the following, namely: For the best quality of wrought iron, in tension, long bars or rods, 10,000 pounds per square inch; for short lengths, 8,000 pounds per square inch, and against shearing force 7,500 pounds per square inch; and for the best quality of wrought iron, in beams either square or cylindrical in section, in compression, the following, namely: Beams having a length of 10 diameters, 8,100 pounds per square inch, with square ends, and 7,400 pounds with round ends; beams having a length of from 10 to 15 diameters, 7,800 pounds per square inch, for square ends, and 6,500 pounds for round ends; beams from 15 to 20 diameters, 7,400 pounds per square inch, for square ends, and 5,500 pounds for round ends; beams from 20 to 25 diameters, 7,000 pounds per square inch, for square ends, and 4,500 pounds for round ends; beams from 25 to 30 diameters, 6,500 pounds per square inch, for square ends, and 3,800 pounds for round ends; beams from 30 to 35 diameters, 6,000 pounds per square inch, for square ends, and 3,200 pounds for round ends; beams from 35 to 40 diameters, 5,500 pounds per square inch, for square ends, and 2,700 pounds for round ends; beams from 40 to 50 diameters, 4,600 pounds per square inch, for square ends, 2,000 pounds for round ends; beams having a length from 50 to 60 diameters, 3,800 pounds per square inch, for square ends, and 1,400 pounds for round ends; beams having a length from 60 to 70 diameters, 3,200 pounds per square inch, for square ends, and 1,100 pounds for round ends, and for beams from 70 to 80 diameters, 2,700 pounds per square inch, for square ends, and 900 pounds for round ends. If iron inferior to the best quality be used, either in tension or compression, the stress on the same shall be proportionately less than the foregoing standard for wrought iron of the best quality.

Sec. 5. Cast iron may be used in the construction of bridges, in compression only, and in lengths not exceeding 20 diameters, at the same stresses as those prescribed for wrought iron by this act, and in shapes other than square or cylindrical, whether wrought or cast iron be used, the stresses shall vary accordingly.

Sec. 6. Where wood is used in the construction of any such bridges, as aforesaid, the greatest allowable strains shall not exceed the following, namely: For oak in tension, 1,200 pounds per square inch; for pine, 1,000 pounds per square inch; and in compression, for oak beams of 10 diameters, 1,000 pounds per square inch; and for pine, 900 pounds per square inch; for oak beams, from 10 to 20 diameters, 800 pounds per square inch, and 700 pounds for pine; for oak beams, from 20 to 30 diameters, 600 pounds per square inch, and 500 pounds for pine; and in oak beams of from 30 to 40 diameters, 400 pounds per square inch, and 300 pounds for pine.

Sec. 7. It shall be the duty of all railroad companies or other corporations erecting a bridge for public travel, whether by contract or otherwise, to keep on the spot a competent engineer to superintend the work, who shall have power to reject



In Presence of

Grand Trunk Railway
Company of Canada
Per J. Hickson
General Manager.

SEAL

The New York Central
and Hudson River Rail Road Company
By Chauncey M. Depew
President

SEAL

The New York Lake Erie and
Western Rail Road Company
by John King
President
Attest A. R. Macdonough
Secretary

SEAL

The Delaware Lackawanna & Western
Rail Road Company
by Sam Sloan
President
Attest
Fred F. Chambers
Secretary

SEAL

Attest
J. D. Layng
Horace Russell
Thos. Houston
As Receivers of the property covered by the first Mortgage of the New York, West Shore and Buffalo Railway Company.

The Pennsylvania
Rail Road Company
by G. B. Roberts
President.
Attest:—
Jno. C. Sims Jr.
Secretary.

SEAL

The Baltimore and Ohio Rail Road Company
Subject to the reservation that it will
be bound by the provisions hereof so far
as relates to Passenger traffic, only
in case it is a member of the Trunk
Line Passenger Division
by
President

SEAL

Attest
Secretary

SIGNATURES TO TRUNK-LINE CONTRACT OF NOVEMBER, 1885.

any piece of material which may have been injured or which may be imperfect from any cause.

Sec. 8. All railroad bridges in this state used for public travel and having over a 15-foot span, or having a truss, shall be inspected once every month by some competent person appointed by and in the employment of the corporation owning or using the bridge, for the purpose of seeing that all iron posts are in order, and all nuts screwed home, that there are no loose rivets, that iron rails are in line and without wide joints, that the abutments and piers are in good condition, that the track rails are smooth, and that all wooden parts of the structure are sound and in proper condition, and that the bridge is safe and sound in every respect. The person so inspecting railroad bridges shall, as often as once in two months, make report, under oath, giving a detailed statement of the condition of each bridge to the general manager or superintendent of the railroad company employing him, who shall forthwith forward the same to the commissioner of railroads and telegraphs, and such inspection, in whole or in part, shall be made and reported as aforesaid oftener than once in two months, if required by said commissioner, and it shall be the duty of said commissioner to prescribe the form of blanks to be used by such inspectors of railroad bridges, embracing such information as said commissioner may desire.

INSPECTION OF BRIDGES.

The provisions in the above bill for the inspection of bridges, pertaining, first, to the material used, and second, to the condition of the structure when finished, have given rise to much discussion relating to the manner in which these important duties are discharged, and what steps should be taken, either by governments or companies, or both, to insure entirely reliable inspection of each of the descriptions indicated. It is to be regretted that there is frequently too much laxity, which occasionally leads to the acceptance of material that should be rejected, and to a practice of inspecting bridges from the rear end of a progressing train, which would be ridiculous if it did not represent a species of trifling with serious affairs that is reprehensible.

NOTABLE NEW BRIDGES.

KINZUA VIADUCT.

ONE of the most notable new works completed in 1882 was the Kinzua viaduct, which was alleged to be the highest bridge structure in the world. It is located on a branch of the Erie, or New York, Lake Erie and Western Railway, that runs through the Bradford oil regions of north-western Pennsylvania into the Elk county coal fields. The roadway is 2,065 feet above sea level, on a spur of the Allegheny Mountains, which is intersected by the Kinzua gorge, through which the Kinzua creek runs. To span this gorge under conditions that would save the construction of about eight miles of road, and ensure a relatively straight and direct line, the construction of the viaduct was recommended, after elaborate surveys, by Oliver W. Barnes, chief engineer of the branch road before it passed under the control of the Erie. Bids were invited, and the design for iron work by Messrs. A. Bonzano and T. C. Clarke, of Messrs. Clarke, Reeves & Co., were approved by Mr. O. Chanute, the chief engineer of the Erie Railway. The viaduct is at its highest point 301 feet above the base of the gorge, and 2,050 feet long, single tracked. It contains 3,500,000 pounds of iron and cost $275,000. It is intended to be strong enough to sustain a live load consisting of a train of consolidation engines. There are twenty towers; the height of the iron work of the lowest is 16 and of the highest 278 feet 3 inches. Of the foundations it is stated that they are founded upon rock, shale and gravel, and in a few cases timber cribbing was used below the level of the stream. There are 112 masonry piers and abutments built of a hard sandstone.

THE CANTILEVER BRIDGE OVER THE NIAGARA RIVER.

In 1884 a new railway bridge over the Niagara river was completed, which attracted much attention, and gave an impetus to a style of construction which applies the most modern forms of arranging the details of the superstructure to one of the most ancient of the primitive methods of constructing bridges, which is by fastening the roots of a tree in each bank, and twisting together their branches in the middle of the stream. In the new Niagara bridge, the completion of which was quickly followed by the erection of other structures of a similar description, a tower was first erected on each of the opposite banks. Each tower supported near its centre a girder with a horizontal top and an inclined bottom chord. These two girders did not meet in the middle of the river by about 120 feet, and they were connected by a straight and suspended truss placed between them. The shore arms being first furnished, their extreme ends were securely anchored to a mass of masonry that far exceeded in its dead weight the lifting tendency of the dead and live loads upon the river cantilevers. With the shore arms firmly held down, it was possible, by an appropriate truss, to build out the river arms, panel by panel, until the whole space was spanned by the meeting of the two river arms and the intermediate truss. Work was carried on simultaneously from both sides of the river. At the crossing point the Niagara river is about 450 feet wide, and the distance from the base of rail on the finished bridge to the surface of water is 239 feet. The quantity of material used in the bridge and towers, exclusive of approaches, is as follows: Steel, 1,272,900 pounds; wrought iron, 3,093,000 pounds; cast iron, 126,000 pounds; total of steel and iron, 4,491,000 pounds; timber in floor, 154,000 feet B. M.; Beton in foundations, 31,100 cubic feet; masonry in piers, 2,800 cubic yards; masonry in anchorage piers, 900 cubic yards. The bridge was designed by C. C. Schneider, member of the American Society of Civil Engineers, and chief engineer of the Niagara Bridge Company.

NEW BRIDGES AND METHODS OF CONSTRUCTION.

References to important new structures as well as to the tendencies prevailing in 1886 are contained in the following extracts from the annual address delivered at the Denver convention of the American Society of Civil Engineers, in July, 1886:—

"The greatest activity in any branch of civil engineering during the past year seems to have prevailed in bridge construction. Quite a number of important bridges have been completed, among them the bridge across the Susquehanna river, on the Baltimore and Ohio Railroad, 6,315 feet in length, and having 4 spans of 480 feet and one of 520 feet; the Henderson bridge, across the Ohio river, 3,200 feet in length, with one span of 525 feet; and the St. John's river cantilever, 447 feet between piers, and the bridge across the Big Black river. Of large bridges in course of construction, the most important is the Forth bridge, with 2 spans of 1,700 feet each, and the Sukkur bridge, across the Indus, having a span of 790 feet; the Tay bridge, and finally the Lachine bridge on the Canadian Pacific Railroad, with two spans of 408 feet.

The contract for the erection of a bridge at Hawkesbury, New South Wales, has lately been awarded to one of our American bridge companies—a very gratifying fact when it is considered that the contract was obtained in competition with the bridge companies of England and France. The main difficulty to be overcome in the construction of this bridge lies in its deep foundations, which are to be sunk to a depth of 170 feet below the surface of water. . . .

Bills have been passed authorizing the construction of bridges over the Mississippi river at Memphis and Vicksburg, and over the Ohio river at Cairo; also over the Mississippi river at Alton. A bill for a second bridge across the Mississippi at St. Louis is pending.

The extremely low price of iron and steel greatly favors the selection of long spans for bridges, as the saving in piers and foundations balances the extra cost (per lin. foot) of long spans.

It has become possible to build bridges of such dimensions through the substitution of steel for wrought iron; but it must, at the same time, be confessed that our knowledge of the properties of this comparatively new material, under the heavy duties which it is called upon to perform, has not kept pace with the general use into which it has suddenly come; and few questions are more interesting, and at the same time of graver importance to the engineering profession, than a careful and conscientious study of the strain to which we are justified to subject the same.

The tendency among bridge engineers at present seems to be favorable to the selection of systems in which the strains to which any member may be subjected can be accurately determined by calculation, and the use of the pin joint, which may be called a distinctive feature of American bridge construction, favors the attainment of this object. Another feature, which I venture to propose to our engineers as being desirable, is that, as far as practicable, the different members be so disposed that they will be subject to strains in but one direction.

The rapidity with which bridges with pin joints can be erected is an immense advantage, particularly when material for such bridges has to be prepared at a great distance from its final destination, or when erection has to take place where no facilities for doing iron work exist. This system of construction is, therefore, particularly adapted for new and thinly-settled countries, and it is a matter of surprise to me that English engineers have not more extensively adopted it for their colonies.

Since the great success of the cantilever bridge at Niagara Falls, a number of other bridges have been built on this principle. Indeed, by far the greater number of long-span bridges lately proposed are to be cantilevers, as this system offers great advantages in erection. But they are subject to greater deflections than those built on other systems, and I believe that the arch might, in many cases, be preferable, as it gives almost the same facilities in erection, and is less deflected under the action of a moving load."

FOUNDATIONS OF BRIDGES.

The most difficult labors involved in the construction of many bridges relate to the establishment of firm foundations. It is largely on account of such difficulties, intermingled on some streams with the necessity for avoiding obstructions to navigation, that remarkable additions to the available length of spans have been made. The chief difference between American and European practice in deep water has been in the relatively free use of timber in this country. An article on foundations, in the November-December, 1878, number of Transactions of the American Society of Civil Engineers, says: "Many of the most important railroad bridges have their piers founded on timber cribs filled in with stone, the timber work being carried up to within a couple of feet of lowest water mark before starting the masonry. On bottoms subject to erosion a plentiful supply of rip-rap is dumped around the foundation, and replenished from season to season until well solidified. This is the most common system employed throughout Pennsylvania and New York, and in fact in all states where the character of the river bottoms is of such a nature that a solid bearing on rock, hard pan, or gravel can be insured. Where a soft material overlies a hard bottom, loose stone is thrown in, which soon forms a solid bearing for the crib work, or the crib is built tight with square timbers, with an open bottom, sunk by temporary loading, the soft material—mud, sand, or silt, as the case may be—sucked out by pumps, or dredged out, as may best apply to the circumstances, the void then being filled in with concrete or broken stone. In case of a rough or sloping bottom, the lower courses of the crib are made to conform to it as nearly as possible, from previously determined soundings. Many of the cribs used are of round logs, notched at their intersections, and secured with long drift bolts. For bottoms ill-adapted to crib work, the most usual practice is to drive piles, the area of the foundation having been previously dredged below scour, if possible. The piles are cut off truly level by means of a horizontal saw on a vertical shaft, or the simple device of a pendulum saw, and as close to the bottom as possible. The interstices between the piles are leveled up with stone. On the bottoms so prepared a crib is sunk, economizing the masonry up to near low-water mark, or a timber caisson is floated over the piles, the bottom of which forms the platform for the masonry, which is carried up in the usual way as in the open air. To control the flotation, a valve is sometimes provided in the caisson, through which water may be admitted, to be pumped out again as occasion requires. The sides of the caisson are detachable, and are used again, should there be more than one pier to found. A modification of the former method has been practiced by depending on the *piles* for the immediate bearing of the platform, and using a timber crib as a protecting envelope surrounding them, all voids being filled up with stone or concrete. In this case the piles, of course, are cut off at the distance below low water that it is desired to commence the masonry. In all cases where there is any possible chance of scour it is usual to protect the area surrounding such foundations by means of rip-rap.

Exceptional works often require expensive methods; but even such works, in this country, are of very recent dates. The application of the pneumatic system, so long practised in Europe, to the foundations of the East river and the St. Louis bridges, are examples familiar to the profession, having been detailed at length in the printed reports of their respective engineers. They are probably the most extended examples of the system extant, and required great boldness and constructive skill to carry out. Two notable improvements were developed in the construction of the St, Louis bridge piers, viz., the use of the water column for driving out the sand through pipes, and the placing of the air lock at the bottom of the well, leaving the long ascent and descent of the workmen to be accomplished in the ordinary atmosphere. The common European practice of using iron cylinders with the pneumatic system, has been applied in this country to but few bridges, of which that at Omaha is the most extreme example."

Since 1878 there has been an increasing tendency to use the pneumatic system in efforts to secure reliable foundations on some of the deep rivers of the country, especially on the Platte, Missouri, and Mississippi, and improvements have been made in the appliances used.

STATIONS AND TERMINAL FACILITIES.

THERE are no features of the American railway system that have undergone more important changes and advances, on progressive lines, than those relating to way and terminal passenger and freight stations, and shops for repairing and sometimes for constructing locomotives and cars.

SUPPLIES OF WATER AND FUEL.

There is one class of things a railway must have before it can be operated, at various points on its line, viz., water tanks, pipes, or other appliances by which water supplies can be conveniently furnished to locomotives. As a prime necessity they are universally provided, but the particular methods used have, like everything else connected with railways, undergone a variety of improvements. One of the most noticeable is a method used on the main line of the Pennsylvania, of having long tanks on the track, from which water can be drawn by locomotives while they are running rapidly, but a much more common practice is the substitution, at stations, of various devices for such tanks as formerly were often placed in the second story of a wood shed, from which supplies of locomotive fuel were drawn. Modern tendencies are indicated by the fact that the Chicago Exposition of Railway Appliances, held in 1883, offered premiums for the following articles under the head of pumps and water-station appliances: Steam pump for water station; hand pump; hydraulic ram; water column or stand pipe; water tank; water tank fixtures; windmill for water stations. Wood sheds on the ground floor, and water tanks above them, formed substantially all the structures of some of the old lines, during the wood-burning era, except a few buildings which contained limited shop facilities; and even at the present day some new lines are completed in accordance with such precedents, nothing being furnished except what is absolutely necessary; which consists at the outset of a provision for furnishing water and fuel to locomotives.

GRADUAL INCREASE OF STATION AND TERMINAL EXPENDITURES TO ENORMOUS SUMS.

From this crude beginning many advances are soon found to be exceedingly desirable, and with the growth of traffic they rapidly became indispensable. On the degree of judgment and success with which these advances are made, the time and methods adopted, the extent and characteristics of improvements, the prosperity or adversity of many lines has largely depended. Some companies have done too much and some too little. Many have failed to do the right thing at the right time, and through procrastination lost golden opportunities for securing considerable quantities of land cheaply, which it afterwards became necessary to purchase at high figures. Some companies have paid large sums for terminal lands which they were not prepared to utilize, and thus created an interest account which has been a serious drain on their treasuries through a protracted period.

But whatever may be the special features of the policy, or good or ill fortune of any given company, it may usually be set down as an approximate estimate, with all important American lines, that after they have been in operation for some years the outlays made from time to time for stations, depots, shops, and various classes of terminal facilities, gradually grow to such proportions that they represent a sum larger than the entire cost of the original road.

It is often necessary and profitable to make the bulk of such additional outlays, and one of the most important sources of the prosperity of some lines is derived from the improvements they provide. It is comparatively easy to build a railway extending between two cities, but it is often found very difficult and expensive after the main portions of such a line have been finished to secure an effective entrance into or near the business centre of either of those cities, especially if they are old and populous, and without such approaches the railway almost inevitably becomes a failure.

EXTENT AND COST OF TERMINAL FACILITIES AT VARIOUS POINTS.

Indications of the magnitude of outlays for terminal improvements at various places are furnished by the following statements, and at a number of other prominent traffic centres expenditures on a corresponding scale have long been progressing.

The report of the investigating committee of the Pennsylvania Railroad Company, published in 1874, says, under the head of Terminal Facilities:—

"We repeat the summary of the estimates of the real estate, buildings, and improvements as follows:—

Philadelphia division	$13,319,133 75
Middle division	4,806,598 00
Pittsburgh division	9,679,509 08
Amounting in all to	$27,865,240 83

These investments of capital are mainly in the cities of Philadelphia, Columbia, Harrisburg, Altoona, and Pittsburgh. About $22,000,000 has been expended for terminal facilities, machine and repair shops, &c."

Since this statement was published important additions have been made to the terminal facilities of the company, especially in the city of Philadelphia, including the purchase of the old Navy Yard and creation of extensive wharves, docks, and landings available for commercial purposes, and the construction of an elevated railroad leading to the new Broad Street Passenger station, located in the heart of the city, and one of the finest edifices of the kind in the country.

The Philadelphia and Reading Railroad Company has extensive terminal facilities in the city of Philadelphia. Its piers and wharves at Port Richmond were long famous as the leading work of the kind in the United States. A water front of about two miles is occupied with 23 piers and docks. There are 18,000 feet of dock room for coal alone, and about 5,000 feet for miscellaneous freight. By recent improvements facilities have been created for promptly and cheaply loading vessels of the largest class used in the coal trade. The depth of the water in some of the coal docks never falls below 23 feet. The piers are connected with the main road by 44 miles of railway track, 11 miles of which are used for the delivery of coal to vessels. The company also has many useful terminal facilities in other portions of the city.

The annual report of the New York Central and Hudson River Railroad Company for the year ending September 30th, 1886, in its enumeration of the items of the cost of the road and equipment, amounting in the aggregate to $146,630,689.19, includes the following: Passenger and freight stations, buildings and fixtures, engine and car houses, machine shops, machinery, and fixtures, $14,740,303.71; land, land damages, and fences, $15,089,201.83. The report also states that the company has 58 engine houses, with 638 stalls; 12 machine shops, 7 car shops, and 5 elevators, with an aggregate capacity of 3,450,000 bushels.

A detailed estimate of the railway terminals used in connection with the traffic of New York, and located in that city and Jersey City, and other points contiguous, made a few years ago by Gratz Mordecai, civil engineer, is to the effect that they include 200 miles of track, which cost $2,000,000; 378 acres of yards, which cost $20,000,000; 22,000,000 square feet of piers, which cost $2,200,000; 2,000,000 square feet of covered floor area, which cost $1,000,000; 890,000 square feet covered at New York city stations, which cost $5,400,000; 69 yard engines, which cost $600,000; 44 propellers, which cost $1,100,000; 230 lighters, which cost $2,100,000. The aggregate estimated cost was $35,000,000. The cost of maintaining and operating, per annum, including investment charges, was $5,460,000. The number of employés was 4,700, and the number of tons of coal used per day was 450.

Specially extensive terminal facilities have also been established at Buffalo. They were largely increased since 1880. In Chicago, Boston, Baltimore, St. Paul, Pittsburgh, Kansas City and indeed all important progressive commercial cities additions of material consequence have been made during late years.

The money value of the railway terminal facilities in a number of cities is much greater than their cost, on account of the rapidity with which the price of real estate in their vicinity has advanced since they were purchased, and any attempt, at the present day, to obtain corresponding property would either be wholly unsuccessful or require enormous expenditures. This fact does much to restrain undue competition for traffic originating at important traffic centres.

SPECIAL ENDS SERVED.

To describe the terminal facilities of even a single important company in detail would require more space than is available. Reference can only be made to their general characteristics. They are leading adjuncts of the great work involved in the process of alternately concentrating at, and distributing from, traffic centres, all the commercial products of industry. Some of the most prominent purposes they serve are the convenient delivery of live stock, at yards in the vicinity of abattoirs, a business that has of late years been supplemented or partly supplemented, to a considerable extent, by the transportation to eastern cities of large quantities of dressed meat from Chicago or elsewhere, and the erection of appropriate edifices for its reception; the creation of conveniences for steamship and other vessel business; the economical movement of grain, which includes the erection of numerous elevators in which it can be cheaply stored, unloaded from cars, and reloaded into wagons, cars, or ships; the handling of coal, whether it is intended for railway uses, local trade, or transhipment to vessels; the special movement of various products, including ice, petroleum, cotton, lumber, and sundry classes of merchandise. Aside from all other developments the extension of tracks to the warehouses, stores, or manufactories of various large shippers forms an important class of improvements, and another large class consists of facilities for the delivery of freight at numerous wharves and landings, from barges or floats owned or controlled by railroad companies. Competition has been a great incentive to the expansion of the scope of all kinds of terminal facilities, and each company that desires to keep pace with its rivals is compelled to make material additions from time to time to the capacity and descriptions of accommodations furnished to the shippers of large traffic centres.

The measure of the usefulness, and consequent ability to obtain patronage, of any railway depends upon the character of its terminal facilities. Stations must be placed at accessible and convenient points, even if large expenditures are necessary to attain that end. The economical movement of freight to foreign countries, or from one native city to another via water routes, requires that tracks should be laid down to wharves in which gigantic steamships can float, and in lake and river cities corresponding facilities must be supplied.

For passenger traffic, accommodations for arriving and departing trains, waiting and baggage rooms, ticket offices, and sundry other conveniences, should be erected in large centres and at numerous points along a line. These requirements are now met in a creditable way at a number of places, although there remain many others at which there are still deplorable deficiencies.

As the condition of locomotives and cars must be kept at a high standard, and the terrible wear and tear to which they are subjected constantly causes defects which must be promptly remedied, numerous shops are indispensable. Of the entire railway system it may be said, with respect to the matters discussed, that it is in a transition state, with a strongly-marked tendency, during prosperous years, towards a notable improvement.

In the eighth decade, and since that time, the necessities indicated received a more general recognition than at any previous period. In a few instances railways were built which, at the outset, contained an unusually large proportion of the appurtenances experience had shown to be indispensable, and a considerable proportion of such new enterprises as are well backed by capital now commence providing extensive shop, station, and terminal facilities at a much earlier period in their history than was formerly common.

TERMINAL FACILITIES AS A GAUGE OF A ROAD'S CAPACITY.

Particular importance was attached to arrangements for increasing terminal facilities during the early portion of the eighth decade, on account of the granger agitation and congressional investigation of transportation routes to the seaboard, because these facilities were properly considered an essential element of such an increase of the available capacity of railways as was required by the growing needs of great national interests. While traffic is confined to a few trains each way daily, the accommodations for loading and unloading and shifting cars are of comparatively small importance, and as this is the normal state of many new lines, they suffer comparatively little inconvenience from their lack of facilities. But when business grows to an extent represented by scores of freight trains and many passenger trains running at varying rates of speed each way, daily, a time arrives when the capacity of a line is gauged by the character of its terminal facilities. Without adequate provision for promptly dispatching different classes of freight on different tracks radiating from a common main line, and such conveniences for shifting cars and remaking up trains as are furnished by extensive yards, supplemented by distinct commodious places for discharging bulky products like live stock, lumber, petroleum, coal, and grain, together with appropriate warehouses for receiving and delivering miscellaneous merchandise, and adequate facilities for passenger movements, any attempt to perform the amount of work now performed daily at the terminal points of great lines would result in inextricable confusion, and establish chronic chaos of the distressing kind represented by a practical blockade.

We are told by a veracious historian that "the army swore terribly in Flanders," and if railway managers and employés ever imitated this bad example in chorus, such a deplorable occurrence is most likely to happen when their road is "blocked" through inability to promptly load, unload, distribute, and move arriving and departing trains.

There are terminal points in the country where more than a hundred passenger trains arrive and depart daily from a single station, and on the adjacent lines more than a hundred freight trains are frequently moved daily in each of two different directions. Where proper facilities exist such complicated and extensive transactions can be conducted without disorder or serious difficulty. If a sufficient number of tracks are provided, and adequate interlocking systems are supplemented with appropriate special provisions for each important class of traffic, it would be hard to assign limits to the capacity of a railway. There is said to be a point on an English road where seven hundred trains pass daily, and this statement indicates the magnitude of the movements that may be performed within a comparatively limited space, if adequate safeguards, tracks, and terminal facilities are supplied.

REDUCTIONS OF COST AND TIME FOR LOCAL MOVEMENTS.

It would be a comparatively cheap and simple matter for a railway company to provide such facilities as are necessary to handle all the traffic offered or received at terminal points if there was not a strong desire to increase traffic by cheapening the cost of local freight movements, and the time required for travelers to reach passenger stations; but provisions are often made for receiving and delivering freight at numerous points which are comparatively distant from the original end of the line, and for establishing central passenger stations at points most convenient to the bulk of the persons served, even when these objects can only be attained by enormous expenditures. The economy of modern rail movements, as compared with the ordinary service of drays and wagons, is so great that the sums paid for moving a ton for a few miles through a city have frequently exceeded the amount paid for making a similar movement over hundreds of miles on steam roads, and there are many transactions which would be rendered practically impossible by diminutions or annihilations of profits, if convenient terminal facilities did not furnish opportunities for avoiding such damaging outlays. Step by step, and year after year, so much has been done in the directions indicated, and in increasing the conveniences for transferring the contents of cars into ships, and the contents of ships into cars, that these labors form a very notable feature of the transportation development of the country, and go far to explain the extraordinary cheapness with which gigantic commercial movements are now conducted.

RAILWAY YARDS.

Indications have already been given of the important part which railway yards play in the handling and distribution of traffic at leading terminal points, but their full significance is often underestimated. The multiplicity of tracks, frequently extending over a considerable distance, affords facilities for promptly assorting the cars conveying different classes of merchandise or destined to different points, and thus separating and remaking up trains. This work requires an immense amount of space, a great deal of switching, or moving cars from one train or place to another. An idea of the magnitude of yards and yard room and the length of the tracks they contain is furnished by the statement that in 1884 there were in the yards of the railways radiating from Buffalo 436.10 miles of track. A tabular statement of the uses to which it was applied, published in A. M. Wellington's work on the Economic Theory of Railway Location, divides it as follows, in miles: Main track, 155.09; passenger stations, 6.08; freight trains from the west, 12.81; from the east, 29.90; from Canada, 8.75; to Canada, 17.84; distributing for west-bound freight, 17.22; transfer, 15.81; lake freight, 13.27; coal, 29.27; stock yards, 9.38; storage for empty cars, 13.00; local city freight, 20.72; shops and coaling, 39.05; miscellaneous, 47.91; freight side track only, 274.93; grand total, 436.10. Very large additions have since been made to this mileage, and although the aggregate amount of space and length of track devoted to railway yards in Buffalo is unusually great, it is typical of corresponding provisions in a number of other places. The practice of different companies varies considerably in the extent to which reliance is placed upon yards chiefly, or almost exclusively, for the re-assorting and distribution of freight, in contradistinction to completeness of supplementary arrangements for different classes of traffic,—but all important companies use yards very extensively; and labors in them form such an important portion of railway transportation that it has been referred to as a work divided into two general heads, one of which consists of work on the road and the other of work at division and station yards.

Different portions of yards or distinct yards are set apart for special purposes, indicated by such titles as oil yard, coal yard, east-bound yard, west-bound yard, grain yard, empty yard, passenger yard, fast freight yard, receiving yard, &c.

It is in the yards, mainly, that trains are broken up, and arrangements made for sending each car to an appropriate destination, and that trains are made up of the particular cars which form them.

PASSENGER STATIONS.

Improvements in the station accommodations for travelers attract much attention because they fall under the immediate notice of millions who utilize passenger trains. The advances at many places are marvelous. At numerous points it may be said that railway stations have been transformed from the meanest and most despicable to the most elegant and commodious structures intended for extensive public use. There have been and still are innumerable Mugby Junctions, but there are also many marvels of architectural elegance, and there are few periods when notable additions to their number are not being made. Much remains to be done, however, before complete changes will be effected in the situation of affairs described by an English writer in the last half of the eighth decade, when he said that "the stations upon American railroads are as a rule conspicuous by the absence of the accommodation and convenience which characterize the stations on English or Continental railways. There are, of course, exceptions to this general rule, which are found at the terminals of trunk lines in great cities, and at a few special points, chiefly summer resorts or centres for suburban residences. As for the stations serving small outlying towns, they consist of little more than rough sheds, giving shelter, but nothing more, while the absence of platforms and of railway officials tends still further to mark the characteristics of these stopping places. Upon second-class lines, especially in the Southern states, the popular criticism upon a slow train, that 'it stops at every wood pile,' has in it not much of exaggeration. The reason for this disregard of appearances, and of the comfort and convenience of passengers, is a simple and obvious one. The railway company cannot afford to spend large sums in station accommodation, and the absence, or rather reduction in this item of expenditure, is one of the causes why railroads in the United States are built so cheaply. Travelers habituated only to the necessities of station accommodation see no reason for complaint if they have to commence their journey from a rough timber shed, devoid of furniture except for a few wooden benches and the universal stove, and complete it on the narrow platform of a dark and dirty terminus, or they might console themselves with the reflection that had greater things been attempted in this direction the railway would never have been built at all."

On a number of lines great improvements have been made during late years. Terminal stations have been brilliantly illuminated with electric lights; all their accommodations and characteristics have been much improved, and even in the matter of absence of railway officials at stations little or no cause for complaint has been left, in view of the activity and courteous attentions and assistance rendered by brakemen and conductors.

GRAIN ELEVATORS.

ONE of the most striking objects connected with terminal facilities is grain elevators. Small ones have been constructed at many places, and large ones at all the prominent north Atlantic seaboard and lake cities. At Chicago they are most numerous. An account of the elevators of that city, published in June, 1887, says:—

"The grain elevators in Chicago represent a capital invested of $10,000,000, and a capacity of 27,000,000 bushels of grain. They give regular employment to 600 men, whose average wages are $2.50 per day. Following is a list of the elevators and the storage capacity of each:—

Name of elevator.	Capacity, bushels.
Central elevator A	1,000,000
Central elevator B	1,500,000
Chicago, Burlington and Quincy elevator A	1,250,000
Chicago, Burlington and Quincy elevator B	800,000
Chicago, Burlington and Quincy elevator C	1,500,000
Chicago, Burlington and Quincy elevator D	1,800,000
Chicago, Burlington and Quincy elevator E	1,000,000
Rock Island elevator A	1,500,000
Rock Island elevator B	1,100,000
Galena elevator	700,000
Air Line elevator	700,000
North-western elevator	500,000
Fulton elevator	400,000
City elevator	1,000,000
Union elevator	800,000
Iowa elevator	1,500,000
St. Paul elevator	900,000
Illinois river elevator	175,000
National elevator	1,000,000
Chicago and St. Louis elevator	1,000,000
Wabash elevator	1,500,000
Indiana elevator	1,500,000
Neely & Hambleton's elevator	600,000
Chicago and Danville elevator	350,000
Pacific elevator A	500,000
Pacific elevator B	1,000,000
George A. Seaverns' elevator	900,000
E. Hess' elevator	250,000
George A. Weiss' elevator	300,000
Total capacity	27,025,000

In addition to the elevators named above the St. Paul railroad is now engaged in driving piles on Goose Island for the foundation of the largest elevator in the world; it will have a capacity of 4,000,000 bushels, and will cost, it is estimated, over $600,000. Besides the grain received by rail, lake vessels brought to Chicago during 1886, 8,379 barrels of flour, 29,361 bushels of wheat, 3,000 bushels of barley, and 3,980 bushels of oats, and during the same period there was shipped by lake 1,319,235 barrels of flour, 10,513,126 bushels of wheat, 40,956,177 bushels of corn 3,219,833 bushels of oats, 114,025 bushels of rye, and 282,946 bushels of barley."

The use of elevators is not confined to the transfer of grain, either from cars to vessels, or from vessels to cars, or from one class of water craft to another. They also furnish facilities for storing and weighing.

AN ERIE ELEVATOR.

A good brief description of the character of the work performed in them, and of the appliances used, is furnished in the following account of one of the Erie elevators of the Empire Transportation Company, contained in the pamphlet it issued, describing its exhibit at the Centennial Exhibition in 1876:—

"Elevator B, erected in 1870, is a frame structure 96 feet long by 72 feet wide, enclosed by substantial brick fire walls, and has a slate roof. The main building is 109 feet, and the tower 124 feet in height. The stone foundations of the building stand on nests of 9 to 15 piles each, that were driven to and rest on the solid rock at an average depth of 17 feet. Surrounding the piling is a sunken crib filled solid with lake sand. Forty-seven separate bins furnish an aggregate storage capacity of 250,000 bushels, and the transfer capacity direct from lake to rail may be estimated at 100,000 bushels per each 24 hours. A steam engine of the most approved construction furnishes the power requisite to do the work of the building. The plan of operating the elevator is as follows:—

A movable ship leg, containing an endless 5-ply rubber belt 157 feet long and 7 inches wide, on which 154 metal buckets of 9 quarts' capacity each are secured, is lowered from the house into the hold of an adjacent grain-loaded vessel. The belt is then started, and elevates the grain to the hopper of a 100-bushel receiving scale, located in the elevator tower, where it is weighed. After weighing, the grain is dropped by gravity into an iron receiver, located below the floor of the building. From this receiver it is elevated on another similar bucket belt to a large distributing bin at the top of the house. From this bin the grain is spouted by gravity into any one of the numbered storage bins, from which it is again spouted (direct into cars), when ready for shipment by rail. Two railroad tracks, accommodating six cars at a time, are located in the building below the storage bins. On each railroad track there is a track scale of the most approved pattern, which is frequently tested by sealed weights, and kept in perfect repair. The light weight of each car is taken on entering the building, and the loaded weight as it passes out—the difference giving the weight of the grain. Each lot of grain is kept entirely separate and distinct from every other, no mixing or grading of grain being allowed. A small sample is taken from each lot of grain handled, and is preserved for reference if desired. Great attention has been paid to making the most perfect provision against fire losses."

DOWS' STORES, IN BROOKLYN.

There are notable variations in the capacity and details of the appliances used in elevators, numerous improvements being made from time to time, and much mechanical skill being displayed in construction. The following brief description of Dows' stores, which, although they appear to be used only for water movements, also represent railway advancements, is printed on the backs of photographs illustrating them:—

"Dows' stores, situated in Brooklyn, at the foot of Pacific street, are used exclusively as a grain elevator. Storage capacity, 2,500,000 bushels. Elevating capacity, 60,000 bushels per hour.

The main building consists of nine compartments, separated by heavy brick walls, extending above the roof, with no communication between compartments. The engine and boiler houses are separate from the building, and made as nearly fire-proof as possible.

Dimensions of main building: Length, outside, 600 feet; height of lower story, 21 feet; number of bins in each department, 40 feet; width, outside, 100 feet; depth of bins, 52 feet; number of bins in all compartments, 360. These are subdivided and used for special purposes.

Height from wharf to top of front of main building, 82 feet; length of wharf from end of building, 600 feet; length of wharf room for vessels, south side, 580 feet; height of three elevating towers on stores, 176 feet; length of wharf room for vessels, north side, 850 feet; total length of building, 1,200 feet.

Six vessels may be loaded and two barges unloaded at the same time.

Steam is supplied by ten boilers to a pair of 28×48-inch condensing engines, making 90 revolutions per minute. Power is distributed from four driving pulleys, 18 feet diameter, by 40-inch belts to four counter shafts, and from these sent to the different parts of the house by belts and seven sets of wire ropes.

All grain is received by two elevators, on dock, weighed, cleaned, and conveyed to store No. 1, dropped to other conveyer belts on lower floor, and elevated to the top of most convenient tower above stores, and thence sprouted to storage bins.

There are six cleansing machines, each using about 40,000 cubic feet of air per minute, and having 10,000 bushels capacity per hour. All parts of the house are well ventilated. A hydraulic elevator goes to the top of engine house and roof. Nearly all machinery is driven by paper friction. Two powerful compound duplex fire pumps connect with the water pipes, which extend to all parts of the house. One pump is constantly working. Electric fire signals, call bells, and telephones connect the different parts of the house. There is nearly one mile of wire rope for the transmission of power and five miles of vulcanized rubber belting in the house, 14,000 feet of which are for conveyers.

The drawings for nearly every part of the house and machinery were made in the engineer's office.

Work was begun May 1st, 1879, and the first grain received May 17th, 1881.

These stores were designed and the construction superintended by George B. Mallory, engineer."

FACILITIES FOR HANDLING COAL, LIVE STOCK, &C.

COAL HANDLING.

As more tons of coal are transported than of any other single article, and as its price requires that the expense of movement from cars to vessels should be kept down to the lowest possible point, places and contrivances devoted to the handling, cleaning, weighing, loading, unloading, and storage and stocking of coal formed the first extensive terminal facilities in the country, and they continue to hold a leading place. Delivering points are numerous, and devices adapted to the wants of different branches of the trade, varying from an annual demand of hundreds to millions of tons per annum, have been adopted.

At the present time (1888) about two millions of tons per annum are transhipped from cars to vessels at Port Richmond, and its terminal facilities include eleven miles of track used in the delivery of coal to vessels. The Philadelphia and Reading has a number of other places for delivering coal. Many other companies have extensive corresponding facilities. The Pennsylvania Railroad devotes a number of piers to transhipments to vessels from cars in the southern part of Philadelphia, and has in operation in connection with its extensive system and its enormous coal traffic, many arrangements, at numerous points, for the delivery of coal. All the roads extensively engaged in anthracite or bituminous coal transportation have created special terminal facilities of considerable importance for this important traffic. The Lehigh Valley has made notable improvements of this kind at Perth Amboy, Buffalo, and elsewhere. The Delaware, Lackawanna and Western has specially advantageous arrangements for delivery in operation at Hoboken. Coal is frequently dumped by opening hinged doors in the bottom of cars, and in some instances this species of unloading is done direct into vessels, while in others the coal is first unloaded into enormous bins, from which it is subsequently taken, in wheelbarrow loads of 224 pounds each, to vessels. At Buffalo special devices for very quickly loading vessels with coal, from enormous pockets, are in use.

LIVE-STOCK YARDS AND ABATTOIRS.

An important feature of the structures of most of the trunk lines at their eastern terminal points is their stock yards or pens for cattle, sheep, and hogs, and adjacent abattoirs in which stock can be slaughtered. During the eighth decade great advances were made in the facilities for the transaction of this branch of business, especially in New York, Philadelphia, and Jersey City. Their character is indicated by the following description of what was done by the Pennsylvania Railroad on the west bank of the Schuylkill river, a few hundred feet north of Market street, in Philadelphia, work being commenced in 1875, and finished in the early part of 1876: On a site which occupied an area of 21 acres, traversed by branches of the main line, the ground was prepared in a thorough manner and paved with granite blocks for pens to hold 7,000 cattle; sheep pens accommodating 10,000 animals; hog pens of about the same capacity; covered sheds for 500 cows and calves; a main office and exchange building, in which sales are conveniently conducted; stable for storing and selling horses; an abattoir, which is an extensive structure, and one of the most complete in the world; a fat and refuse reducing department. The enclosure is laid out in blocks and streets, which are carefully drained and well lighted. The cattle pens are framed and roofed in to the extent necessary to protect the animals from rain and sunshine without preventing free ventilation. There are 172 pens, and all assigned for the use of cattle in approaching trains are provided with water and food before the cattle arrive. There are two sheep enclosures 350×130 feet, and hog pens adjacent. Great efforts were made to prevent obnoxious odors from the stock yards or the operations of the abattoir, which were attended with a remarkable degree of success. Of the abattoir the following account is given in Dredge's work on the Pennsylvania Railroad:—

"The roof of the building is supported on light iron columns, and the pens, &c., are divided off with iron railings. The floors of the pens are laid with Belgian blocks grouted in cement, and they are formed with sides sloping to a central gutter, falling in the other direction to a transverse drain. A stream of water flows constantly along the gutter, and carries off all impurities. Two rows of wrought-iron columns carry the roof, and divide the building into a central aisle 50 feet wide, and two side aisles 30 feet wide each. The middle portion of the building is covered with an arched roof springing 40 feet above the ground. The side aisles are 20 feet in height to springing, and have also a central roof. Along the sides of the building are a number of doors 6 feet wide, and placed 15 feet apart, which are used to admit wagons for the purpose of loading the meat. Ventilators are placed over each door. Large windows are placed at each end of the central aisle, and further ventilation is secured by louvres running along the roof. The floor of the building is supported on cast-iron columns, and the space below forms a basement 11 feet in depth. Both the main floor and the basement are covered with an asphalte pavement 4 inches thick, having a sufficient slope to insure perfect drainage. The work of slaughtering the cattle is carried on entirely on the main floor, that portion set aside for this purpose being divided off into pens, the floor of which is laid with heavy yellow pine planking, carefully caulked. The cattle are admitted through doors in the ends of the building, through which they pass into the middle aisle, and thence through gates into the slaughtering pens, the centre space being fenced off from the sides by iron-pipe railings. Each slaughtering pen is provided with the requisite apparatus, and with appliances for hanging up the carcass and dressed meat. The blood and refuse are removed to that part of the building set apart for their utilization, and an ample supply of hot and cold water is provided. In the winter the building is warmed by coils of steam pipes running around the walls. The place has a capacity for killing and dressing 1,200 beasts a day. The sheep are slaughtered in the basement at the west end of the building. Here is a row of raised pens, enclosed by a wire fence and iron posts, and paved with stone. In front of these pens is a stone table with a gutter running round it for catching the blood of the slaughtered animals. Three thousand sheep can be slaughtered and dressed in this department. In the basement at the east end of the building facing the river (the basement here is on the ground level) is the engine and boiler house, the former being 60 horse-power and the latter equal to 100 horse-power. Here also is placed the plant for reducing the tallow, and treating the blood and refuse from the animals."

There are live-stock yards of great capacity at various places, notably in Chicago; and the business of transporting live stock from Chicago and other western cities to eastern cities has attained great magnitude. Of late years, the east-bound transportation of dressed meat, or cattle slaughtered in the west, has rapidly increased and caused a corresponding diminution of live-stock movements. Material changes have also occurred in the respective quantities of cattle and dressed meat exported to Great Britain and elsewhere. At some eastern points large structures for the storage of dressed meat have been erected.

MISCELLANEOUS FREIGHT.

Aside from special facilities for handling exceptionally bulky articles, such as petroleum, for the movement of which a number of ingenious labor-saving devices are used, and lumber, one of the greatest tasks is to make adequate provision for handling miscellaneous freight. This includes articles of all classes not particularly mentioned elsewhere, and many complications arise from variations in quantities, differences in characteristics, necessity of furnishing many points of final delivery or original loading in each important city, making up car loads of sufficient size to avoid much waste of space without endangering the condition of things subject to injury by contact with other freight, great diversity in points to which merchandise is to be forwarded, and sundry other causes. Various labor-saving machines have been devised to accomplish desired ends, but there are so many kinds of work to be done quickly, under conditions that are constantly varying, that a large force of men is employed, at important traffic centres to load and unload, or move from place to place. The movements to and from New York are exceptionally numerous and varied, partly on account of their great magnitude, and partly because a large proportion of them are made over lines which do not directly enter that city, but terminate on the opposite bank of the Hudson, and which are, therefore, obliged to forward freight to and from New York in floats, lighters, or other vessels. A considerable quantity of freight is moved across the river in cars, which are either loaded or unloaded in New York city, and many articles are moved in packages. Deliveries can be made from Jersey City at any available point on either commercial river front of the city of New York, and the work of transferring railway passengers and freight is of such magnitude that it employs a large number of vessels, and their movements usually form a very large proportion of all those that are being made at any given period in the busiest of American harbors. Ample pier and dock accommodations are, of course, required, and they form an important item in terminal expenses.

RAILWAY SHOPS.

INTERWOVEN with the subject of terminal facilities, and yet distinct from it in some respects, are the shops, which form exceedingly important railway structures. They are divided into several classes, one based on distinctions between car work and locomotive work, and another on the extent to which new construction of cars or locomotives is attempted.

Most of the railway shops of the country are exclusively repair shops, and it is only in a few of them that new locomotives are made. In some, however, excellent locomotives are constructed; in others, many cars have been manufactured; and the most extensive railway combinations for construction embrace facilities for making many of the distinct parts of rolling stock, portions of the permanent way, such as frogs and switches and sundry other things needed in railway service.

As a general rule, shops are used exclusively for repairing, and repair shops differ widely in the relative magnitude of their capacity, or importance of the sort of work they undertake and in the kind of repairs conducted, some being devoted to repairs or classes of repairs of locomotives, and others to repairs of cars. There are also round-houses for locomotives, in which minor repairs are frequently made, and they usually contain a turn-table. Scales, on which cars, freight, or fuel can be weighed, frequently form part of the appliances provided in or near shops, and turn-tables are occasionally erected at points where shops have not been established.

Like everything else connected with the American railway system, the shops have gradually been developed into their present position through a series of progressive changes, a number of which occurred during the eighth decade, additions being frequently made to the machine tools, and other aids to effectiveness provided, the number of men employed, and the character of the work undertaken. There have also been important modifications of methods at some places, such as the introduction of templets and standards of various kinds, the establishment of rules relating to the extent to which repairs should be carried before a locomotive or car is finally condemned and broken up, and similar subjects. Many new shops have been erected, not only by new companies, but to some extent by old organizations, which have frequently felt a pressing necessity for an increase of shop facilities, on account of the rapid increase of rolling stock.

Much depends upon the completeness of provisions for insuring prompt, effective, and economical repairs of cars and engines, and for protection against disastrous mistakes in the selection of parts of equipment and numerous articles required for current use or consumption. The fortunes of a company may be made by successes or marred by failures in its shops.

THE IMPORTANCE OF THE LABORS IN SHOPS

is partly indicated by the relatively high percentage shop expenditures usually bear to the total outlays for operating expenses, and this percentage would be materially increased if a rapid growth of business did not generally lead to numerous additions to equipment, or new locomotives and cars which commonly require, during the early periods of their service, much less than the average outlays for repairs.

The census statistics of 1880 show that the aggregate number of railway employés was 418,957, subdivided as follows: General officers, 3,375; general office clerks, 8,655; stationmen, 63,380; trainmen, 79,659; shopmen, 89,714; trackmen, 122,489; all other employés, 51,694. It will be seen that the shopmen formed more than one-fifth, or about 21.1 per cent. of the entire number. The character of their labors is imperfectly indicated by the census statement that of the 89,714 shopmen, 22,766 were classified as machinists, 23,202 as carpenters, and 43,746 as all other classes. The cost of the repair work performed in all the railway shops of the United States in the census year is shown by the statement that the sum expended for repairs of locomotives was $21,830,963.43; for repairs of passenger, baggage, and mail cars, $10,558,823.99; for repairs of freight cars, $22,595,553.09; total for repairs of machinery and cars, $54,985,340.51. A number of companies made reports relating to locomotives and cars they had manufactured in their shops during the census year, but from many companies no such reports were received.

The general public sees comparatively little of railway shops, but observant travelers who make daylight journeys over important lines, cannot fail to notice the magnitude of some of these structures, and from time to time many interesting details relating to them are published. Nothing is more powerless than a gigantic locomotive when it is disabled by a serious defect in a vital portion of machinery; and few things are more dangerous than cars in active motion on a line at a time when axles or wheels are in a defective condition. The shops provide safeguards against such disasters.

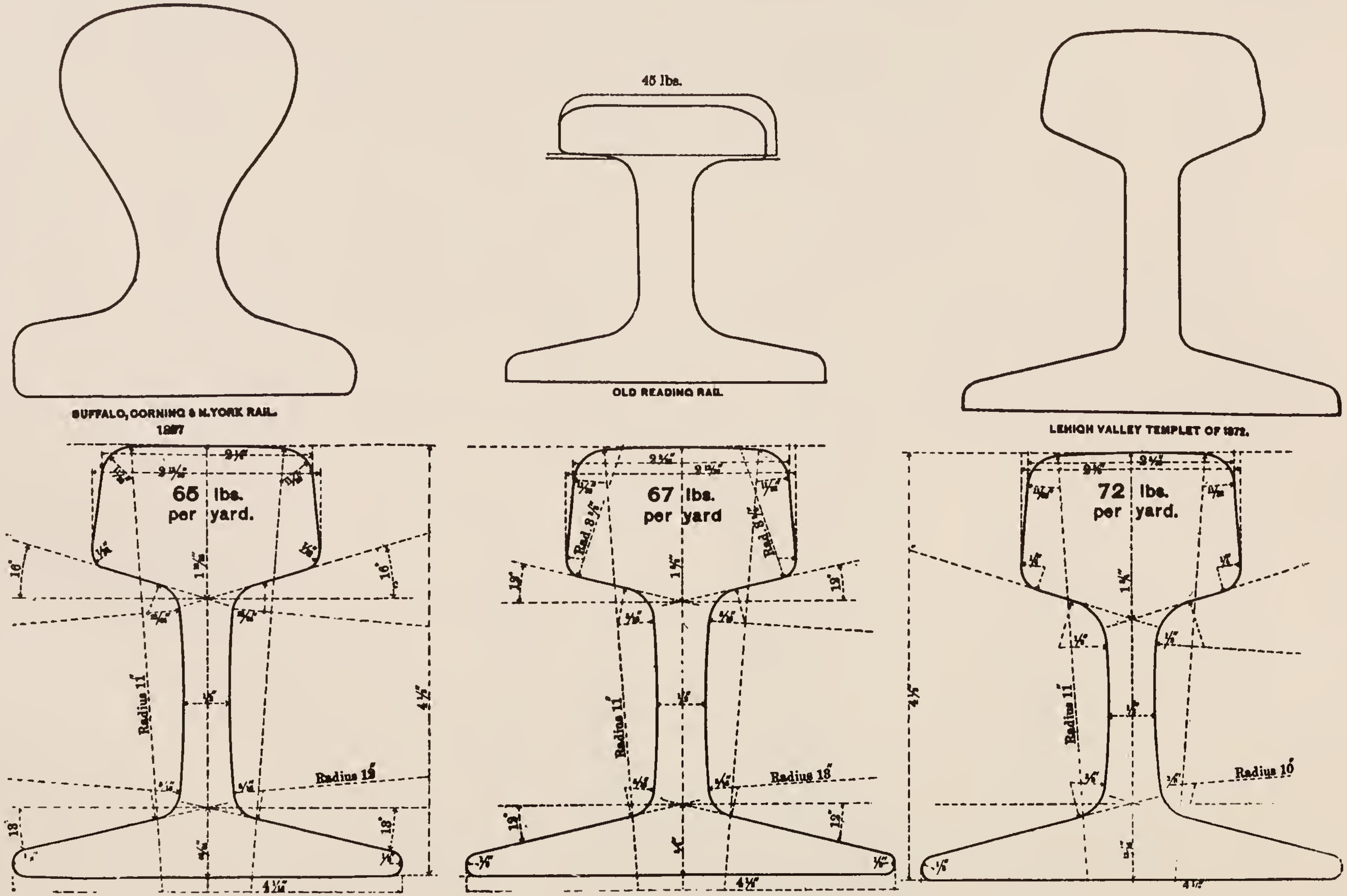
They are also, to a great extent, practical schools of instruction for many important features of railway operation. It was in the brains of men familiar with such surroundings as they furnish, and proficient in such arts as they represent, that the idea of the modern railway was first conceived, and it is largely through the continuous efforts of a long line of worthy successors, who are connected with railway shops or manufacturing establishments devoted chiefly to the production of railway machinery or supplies that numerous improvements have been rapidily made. As difficulty after difficulty has arisen, and one new requirement has succeeded another, many of the most intricate problems involved, and especially such as relate to rolling stock, have been worked out in the shops.

The world has been benefited to an immense extent by the labors that have increased the powers and improved the machinery of locomotives and cars, and a large proportion of such improvements have directly or indirectly either originated or been advanced to a state of practical utility in railway shops, while substantially all the labors required to keep rolling stock in working order have been performed in them.

Labor-saving machinery means a great deal in the United States, and there are no departments of industry in which it has a deeper significance than in matters connected with railways, railway shops, and the manufacture of articles intended for railway use. In the last-named category an immense number and variety of things are embraced, as they include not only prime necessities such as are used by railways, but substantially everything needed in the construction, ornamentation, and furnishing of dwellings, offices, and restaurants.

COMBINATIONS OF FACILITIES FOR CONSTRUCTION AND REPAIRS.

The most extensive shops, which embrace facilities for construction as well as repairs, sometimes include, in addition to other departments, the following, viz.. 1. A machine shop, containing tools for all classes of machine work. 2. A boiler shop, containing all desirable facilities for manufacturing or repairing locomotive boilers. 3. An erecting shop, for putting together all the different parts of a locomotive. 4. A foundry, in which castings of locomotives, cars, and general castings are produced. 5. A vise shop, used for the finishing work of parts of locomotives, and various forgings and castings. 6. A tube shop, in which tubes used in locomotives are tested or repaired. 7. A blacksmith shop, in which there are a number of forges and heavy steam hammers, and a large amount of heavy forging is done. 8. A wheel shop, in which locomotive and tender wheels, and sometimes car wheels, are furnished and mounted. 9. A pattern shop, in which patterns are manufactured and stored. 10. A paint shop, in which locomotives are painted. 11. An oil house, in which waste, oils, tallow, &c., used for lubricating or illuminating purposes are prepared, stored, and arranged for future delivery. 12. Round-houses, provided with



STANDARD RAIL-PATTERNS PROPOSED BY A.L. HOLLEY.

turn-tables, radiating tracks, hydraulic jacks, and various heavy and light tools used in making speedy repairs of locomotives at times when their condition is not impaired to an extent necessary to require a general overhauling. 13. A tin shop, for manufacturing or repairing such light sheet iron and tin work as forms part of a locomotive, or oil cans used in oiling cars and locomotives. 14. A steam transfer table, which provides facilities for the convenient movement of locomotives or cars from one shop to another adjacent shop. 15. A testing department, in which the strength and other qualities of rails, boiler-plate iron, car axles, lubricants, and various supplies and materials are tested. 16. A shop used for repairing and constructing freight cars. 17. A passenger car erecting and repairing shop. 18. A planing mill, containing a number of wood-working machines. 19. Extensive blacksmith shops, for making or repairing iron work of freight or passenger cars. 20. Cabinet shop, in which the fine wood work of passenger cars is made. 21. A machine shop, in which heavy metallic work, connected with cars, such as wheels, axles, &c., is made, fitted, arranged, or repaired. 22. Car-painting and upholstery shops. 23. Sand house. 24. A shop for air brakes.

The above list embraces a mere enumeration of a number of the leading kinds of shops or departments at Altoona. There are besides general offices and extensive drafting rooms in which the details of new work are carefully designed and working plans are prepared; and several important departments not named in the list given above, including a car-wheel foundry in which many wheels are made daily, and a shop for manufacturing and repairing telegraphic instruments and appliances used along the line, extensive lumber sheds and houses for drying and storing lumber.

There is no single combination of railway shop facilities in this country covering so wide a range and extensive capacity as the works at Altoona, which, a few years ago, extended over an area of 123 acres, and furnished employment to 4,500 men, but there are counterparts of some of their principal characteristics at a number of other places. A few railway shops have made things not made at Altoona; and on the other hand, each of any one of many shops contains only a small proportion of the machinery and departments combined there.

As a rule there are shops of considerable importance, in which repairs of cars and locomotives are made, at or near the headquarters of each division of each railway, and the average length of such divisions on some lines is but little more than one hundred miles. There are also some shops for making minor repairs at points which are not located near headquarters of divisions, and the aggregate number of railway shops of all grades runs well up into thousands.

MACHINE TOOLS AND APPLIANCES.

Few, if any, industrial pursuits combine in a set of concentrated shops a larger number of skilled workmen, a wider range of mechanical proficiency, and a more extensive variety of powerful machines and appliances, than leading construction and repairing railway shops. Discussions have arisen from time to time in regard to the extent to which new construction should be attempted in them, but the necessity of great capacity for repairs is universally admitted, as it would be practically impossible for any important railway company to conduct transportation in a satisfactory or successful manner if adequate provision was not made for the speedy and skillful repair of cars and engines. They are subject to many mishaps and injuries; attempts to keep them running when they are in a seriously defective condition are either impracticable or dangerous; and any considerable loss of time in making repairs materially diminishes revenue.

To repair defective rolling stock as speedily as possible, and to keep it in good running order at all times, are objects of supreme importance, and the problems involved have received so much intelligent consideration that modern methods represent great advances. One of the most notable is the introduction in progressive shops of templet systems, so arranged that exact duplicates of a number of the particular parts of an engine subject to injury are kept in stock, and when a disaster happens comparatively little delay occurs; and there is an extension of the range of repairs that can be made in a round-house, by night or by day, without materially diminishing the amount of service performed by a locomotive. The effectiveness of the labors of a given number of shopmen has been materially increased by improvements in tools and additions to their number. Much of the work formerly done by files, for instance, is now done by emery shapers, wheels, or grinders, and year after year new inventions or improvements are perfected which make similar changes in various departments, or reduce the amount of manual dexterity necessary to accomplish given results.

The men and machinery employed must deal with many ponderous substances, and adequate agencies are provided for lifting, moving, handling, shaping, cutting, shearing, drilling, fitting, boring, pressing, punching, sawing, taking wheels off axles, putting wheels on axles, and modifying in all desirable ways bulky masses of wood, iron, steel, brass, and other metals. The hardest of these must be as completely subject to manipulations as wood.

In arranging large railway shops and providing them with desirable facilities, the forces pressed into service embrace air, water, fire, steam, electricity, and many classes of powerful machinery. Air is a vital force in connection with blowers used to increase draughts in blacksmiths' forges. One large blower properly arranged is sufficient to provide all the currents of air needed in a considerable number of forges. The blacksmith is one of the most indispensable of the employés, as much of the iron work must be heated, but the amount of labor he is able to perform in a given period, in comparison with old-fashioned methods, has been greatly increased by the blower, which, driven by machinery, does away with the hand bellows. He is also greatly helped by steam hammers of various sizes and dimensions, a weight of several tons being not unusual, adding immensely to the force of blows made upon heated iron; shaping tools or models which render effective assistance in giving desired shapes; shears or combined shearing and punching machines, and various other devices. Air and water combined furnish the motive power for a number of hydraulic machines and tools, used extensively in putting on and off wheels, in lifting upper portions of locomotives or cars while they are undergoing repairs, in lifting or sustaining heavy weights in foundries or other shops, and in several important classes of riveting operations. Hydraulic machinery is one of the few things more extensively and successfully utilized in railway operations in England than in the United States. The machines used in machine shops and other departments are usually driven by steam power, and much ingenuity has been displayed during late years in improving the devices for increasing the amount of available power taken to each desired point or machine, and also in transmitting steam power to tools which can be freely moved from place to place by flexible shafts. Systems of electric lighting have been extensively adopted in railway shops. Cranes are provided for readily moving heavy masses from point to point, some of which have a capacity for lifting from twenty-five to thirty tons. Few or none of the important modern improvements, relating to methods for applying any of the standard forces to machinery, or to improvements in machines, which could be rendered useful in railway shops, have failed to secure, in them, an extensive representation.

Railway machine shops, in which cold iron, steel, or other metals are manipulated, have been supplied with numerous varieties of machines and tools, including lathes of various sizes and styles, bolt and nut screwing machines, drills, presses, drilling and boring machines, milling machines, planing machines, punching and shearing machines, shaping machines, and slotting machines, in many of which improvements are frequently made, and great advances have been achieved in the wood-working machinery of car shops.

A large proportion of railway-shop repairs relate to running gear, and as wheels are sure to wear out or become defective after a comparatively limited amount of service, they must be taken off or put on axles, an operation that requires an exercise of hydraulic force supplied by hydraulic or hydrostatic wheel presses, which commonly apply to car wheels a pressure of about 30 tons, and to locomotive wheels a much greater pressure, or about 80 tons. It is claimed that some of the wheel presses are capable of exerting a pressure of 150 tons.

While many of the machines, tools, and appliances used in railway shops are also used in shops of various other classes, a considerable number are used exclusively in manufacturing or repairing rolling stock. In brief, it may be said that extensive railway shops contain, in addition to such aids as are peculiar to their own requirements, nearly all important classes of machines and tools used by workers in metals and wood. In addition to appliances to which brief reference has already been made, there are stationary steam-boiler riveting machines, and stationary and portable boiler-riveting machines, which not only greatly increase the amount of work done, but improve the quality of the riveting. There are machines or apparatus for bending, setting, removing, and facilitating the heating of tires, and one of the most striking operations frequently performed is the fastening of the thick steel tires of locomotives to the wheels, to which they are applied by shrinking without any mechanical attachment whatever. The method of performing this operation, which represents a notable advance, has been described as follows: "The tire is bored out smaller than the periphery of the cast-iron centre is turned, the difference being always one-ninetieth of an inch per foot of diameter of tire. The tire is expanded in a heating furnace, and when placed on the wheel it is cooled by water." There are rail-drilling machines, intended specially for making the holes for the joint bolts near the ends of steel rails. In addition to car-wheel-boring mills, there are wheel-quartering machines, on which important labors are performed on locomotive wheels of all sizes, including the largest, and axle lathes in which iron or steel axles can rapidly be reduced to desired dimensions. There are machines and bars for boring locomotive cylinders, flue-cleaning machines, car-box-boring attachments, portable drilling machines for drilling holes in locomotive smoke boxes and cylinder flanges, and machines for turning off crank pins in position, and while wheels are under an engine. In addition to numerous turn-tables at many points on railway lines or in round-houses, railway transfer tables, intended to facilitate the transfer of cars or locomotives from one shop to another, are used at extensive shops.

Each class of important shops is a centre of mechanical labors, progress, and improvements, embracing a mechanical world in itself. In the machine tools and other appliances used the United States leads the world, and it is largely on account of this superiority that American cars and locomotives and the best native methods of manufacturing and repairing them have gained a corresponding supremacy.

An illustration of the classes of machine tools and wood-working machinery used extensively in railway shops is furnished by the following lists of articles for which premiums were offered by the Chicago Exposition of Railway Appliances, held in 1883:—

Iron-Working Machinery.—Display of iron-working power tools, not less than six in number; axle turning machinery; car-wheel-boring and turning machine; six-spindle drilling machine; hydraulic-wheel press; wheel grinding or trueing machine; iron-planing machine; iron-crank shaping machine; screw-cutting-engine lathe; upright-drilling machine; radial-drilling machine; milling machine; bolt-heading machine; bolt-forging machine; bolt- and screw-cutting machine; set-screw machine; gear-cutting machine; power hammer; power punch and shears; planer chucks; universal and independent chuck, over 12 inches in diameter; universal-lathe chuck, 12 inches and under; assortment of lathe chucks; assortment of planer chucks; expanding mandrel; flexible mandrel for bending pipe; adjustable lathe mandrel; differential pulley blocks; machine for testing quality of metals; machine for testing strength of metals; drop press for stamping and forging; display of emery grinding machinery; display of machinists' hand tools; display of machinists' vises; displays of taps and dies; nut-tapping machine.

Wood-Working Machinery.—Display of wood-working machines (not less than six); timber-dressing machine with capacity of reducing 16 inches wide and 14 inches thick, on all four sides at one cut; planing and matching machine, to plane 24 inches wide and under, and not match less than 12 inches; flooring and beading machine; dimension planing machine, with carriage and roll feed for dressing out of rind and surfacing; Daniels or Traverse planing machine; double-surfacing machine to dress on one or both sides, 26 inches wide and 8 thick, and under; surfacing machine for smoothing purposes; band-saw machine for general work; band saw for resawing, to resaw 24 inches wide and under; cutting-off saw machine, with traversing arbor for timbers; bracket cutting-off saw machine, with traversing arbor for timbers; railway cutting-off saw machine, with traversing arbor for timbers; carriage cutting-off saw for cabinet work; ripping saw with elevating arbor; ripping saw with stationary arbor; edging-saw machine; reciprocating saw for scroll work; rotary-car morticing and recasting machine; reciprocating morticing and boring machine; cabinet morticing and boring machine; reciprocating blind-morticing and boring machine; one-spindle horizontal boring machine; two-spindle horizontal boring machine; three-spindle horizontal boring machine; radial horizontal machine; one-spindle vertical boring machine; two-spindle vertical boring machine; three-spindle vertical boring machine; automatic car-gaining machine; vertical car-tenoning machine; universal tenoning machine, with movable carriage for timber work; tenoning machine with copes for cabinet and general work; universal sill and cutting-off and boring machine; vertical spindle-shaping and edge-moulding machine; single spindle and edge-moulding and carving machine; universal wood-worker and moulder; straight moulding machine to work four sides; surface polishing machine; surface scraping and finishing machine; automatic knife-grinding machine; wood-turning machine for pattern makers' use.

In addition to these iron-working and wood-working tools, premiums for sundry other things used in railway shops, or which form part of their equipment, were offered by the Chicago Railway Exposition, aside from the wide range of woods, metals, furnishings, materials, and articles wholly or partly furnished which form parts of cars and locomotives, or are used in making and repairing them. In this class may be included systems for lighting depots and shops by electricity, leather belting, rubber belting, fire-clay brick, cranes, hydraulic jacks, lever jacks, portable forges, tire heaters, turn-tables, power blowers, hand blowers, &c.

WORK DONE IN REPAIR SHOPS.

It is the business of railway repair shops to keep rolling stock in sufficiently good order to render it improbable that accidents, delays, or damages to property will occur on account of defects. Accidents attributed to bad condition of equipment represent a considerable percentage of those reported, and the causes specified include the following: Broken wheel, broken axle, broken truck, failure of coupling or draw-bar, broken parallel or connecting rod, broken car, loose wheel, fall of brake or brake beam, broken tire, boiler explosion, cylinder explosion, miscellaneous breakages of rolling stock. Such classes of accidents would be much more numerous if inspections of cars and examinations of locomotives were not frequently made, and necessary repairs completed as quickly as possible.

Repairs of Cars.

The code of rules governing the condition of and repairs to freight cars, used in the interchange of traffic between connecting roads, specifies in detail the defects of cars. They are divided into two classes, viz., first, those which render the car unsafe to run or unsafe to trainmen, and which, on account of such defects, may be refused by a connecting road, and second, defects which are sufficiently serious to render desirable speedy repairs, that may be made by the company receiving the cars, at the expense of the owners, but which are not of a character to render movement necessarily unsafe.

The defects which justify a refusal to receive cars under the rules adopted by the Master Car-Builders' Association, in June, 1887, are as follows:—

Defects of Wheels.

a. Worn or slid flat, exceeding 2½ inches in length, or diameter.

b. Worn flange, flanges less than 1 inch thick, or having flat vertical surfaces, extending more than 1 inch from tread.

c. Wheels cracked or broken in any manner.

d. Shelled out; wheels with treads defective on account of circular pieces shelling out, leaving round, flat spots, deepest at the edge, with raised centre. Wheels must not be condemned from this cause, unless the spots are over 2½ inches in length, or diameter, or are so numerous as to endanger the safety of the wheels.

e. Wheels with longitudinal seams on treads 3 inches long or more.

f. Wheels clipped on the rim, leaving tread less than 3¾ inches in width when measured from the flange at a point ⅝ inches above tread.

g. Wheels with flanges chipped, so that they are unsafe to run.

h. The determination of flat spots, sharp flanges, thin flanges, and chipped treads shall be made by a gauge of the following form:—

In this gauge the ⅞-inch dimensions are changed to one inch.

Defects of Axles.

i. Axles bent or with journals cut.

j. Axles with journals of less diameter than the following limit:—

	Inches.
60,000-pound car, limit	3⅝
50,000-pound car, limit	3¼
40,000-pound car, limit	3⅛
30,000-pound car (or less), limit	2¾

Defects of Mounting Wheels on Axles.

k. Loose wheel.

l. Out of gauge, or wheels that measure less than 4 feet 5 inches or more than 4 feet 5¾ inches between flanges, or less than 5 feet 4 inches over treads.

Cars may be refused if their wheels measure less than 4 feet 5 inches or more than 4 feet 5¾ inches, or if less than 5 feet 4 inches on the lower line.

Other Defects.

m. Brakes in bad order.

n. Brake wheels, steps, ladders, or running boards in bad order or insecurely fastened.

o. Draw-bars or attachments in bad order.

p. Draft sills or draft timbers spliced.

q. Intermediate or outside sills recently spliced in a manner not prescribed by the rules.

r. Leaky roofs on merchandise or grain cars.

s. Doors which are not sufficient protection against fire or storms.

t. Special or general defects of bodies or trucks, which render cars unsafe to run.

The percentage of the cost of various classes of repairs to cars differs materially on different roads, and varies materially with the classes of cars. From a variety of information the conclusion is drawn by A. M. Wellington, in his work on the Economic Theory of the Location of Railways, that on freight cars the average percentage is very nearly as follows: Wheels, 30 per cent.; axles, brasses, and axle boxes, 30 per cent.; springs, 10 per cent.; truck frames and fittings, 5 per cent.; total truck, 70 per cent.; brakes, 5 per cent.; draw-bars, 10 per cent.; sills and attachments, 5 per cent.; car body, painting, &c., 5 per cent.; total, 100 per cent.

The cost of repairs of passenger cars, in proportion to mileage run, differs from charges for freight-car repairs chiefly in the expense of decorations, interior fittings, and painting.

Repairs of Locomotives.

Of the repairs of locomotives and tenders, A. M. Wellington, in the work referred to above, concludes from a variety of data that "the total cost chargeable to repairs of engines, including removals, may be distributed about as follows:—

	Per cent.
The boiler and its attachments require about	20
The running gear and frame (of which the frame consumes very little, say 2 per cent.)	20
For machinery proper	30
The mountings, fittings, and painting	12
The smoke box and attachments	5
Total of engine	87
The running gear of tender	9
Tank and body of tender	4
	100"

There are so many things about a locomotive liable to derangement, that repairs are frequently necessary, especially after they have been in service for a few years. Of the locomotives of companies engaged in extensive operations, a considerable percentage, usually not far from 17 per cent., are in the shops for repairs, and the average cost of such repairs per mile run has varied on different lines, from five to eight cents.

DEPARTMENTS FOR TESTING MATERIALS.

The disposition to establish departments, connected with central shops, in which various materials, parts of rolling stock, steel rails, &c., could be subjected to sundry tests, including a chemical analysis in some instances, has been to a moderate extent increasing during late years. The general practice continues to be to rely chiefly upon the reputation or representations of the manufacturer, or tests and inspections made at the place of manufacture, which are frequently but not universally elaborate and satisfactory. Of the physical tests and machinery used at Altoona, comparatively soon after its department of physical tests was organized, Dredge's History of the Pennsylvania Railroad, published in 1877, says: "It contains two testing machines, one of which is supplied by Messrs. Fairbanks & Co. This machine is designed to test material to a strain of 50,000 pounds, and is adapted only for tensile and transverse strains. The machine has a scale for reading absolute deflections or extensions to .01 inch, and is supplemented by a vernier which gives readings to .001 inch. Measurements are taken between the shoulders at the ends of the test pieces, which are almost of uniform size, and a percentage of elongation is thus obtained on a definite length. The diameters in widths of samples are calipered to .001 inch. When determined, the load producing permanent set, and the ultimate strength, are stamped upon the sample, which is indexed and placed in store. The principal materials tested for tensile strength are iron and steel bars, cast iron from the shop foundries, steel boiler plates, sheet iron, phosphor bronze, brass, and brake chains. The tests for transverse strains are principally confined to cast iron, from the general and the wheel foundries; usually four samples from the former and two from the latter are tested daily. The pieces are all 15 inches long and 2 inches square, and are put into the machine just as they come from the sand. These test pieces are run from different parts of the same cupola charges, and they are broken by the application of a load in the centre, the bearings being 12 inches apart. The average breaking weights of the wheel mixtures, containing 10 per cent. of steel, is 21,000 pounds per square inch, and the tensile strength is about the same. The strength of the samples taken from engine cylinders, wheel centres, &c., is generally about 14,000 pounds per square inch in samples first taken from the cupola; about the middle of the charge this increases to 16,000 pounds, and rises to 18,000 pounds at the end, where the metal is much harder from the mixture used. These stronger irons are employed for special purposes, such as brake blocks, &c. The tensile strength of all samples is about the same as the transverse strengths given above.

The second testing machine is for recording torsional strains, and was designed by Professor R. H. Thurston. This machine produces during its operation a diagram indicating the value of the test. An ordinate to the curve, perpendicular to the datum line, measured at any point, represents the moment of torsion at that point, while its distance on the datum from O indicates the angle of torsion at that point. The point of decided change in the direction of the course, a short distance from the commencement, marks the elastic limits of the test piece, and various other results can be deduced from the diagram; thus the degree of toughness is indicated, the resilience is shown by the area of the diagram, the homogeneity of the test piece from the form of the curve, and elasticity by occasionally relieving the sample of strain, and noting the deviation of the pencil.

Belonging to the same department, but in another part of the works, is the testing machine for car axles. These are placed under a drop, supported on bearings of cast iron, 3 feet apart from centre to centre. The drop, which weighs 1,640 pounds, strikes the axle in the middle of its length, and is raised in vertical guides by a wire rope passing around a sheave at the top. An old locomotive is employed upon this work.

In testing axles one is selected at random out of every hundred, and if it stands the test the lot is accepted; if not, they are all rejected. For the steel passenger-car axles the required test is that they shall withstand 5 blows from the 1,640-pound drop falling through 25 feet, the axle to be turned half round after every blow. A similar percentage of the steel freight-car axles is also placed under the test, the requirement being 5 blows from a height of 20 feet, and for iron freight-car axles, 3 blows at 10 feet, and 2 at 15 feet.

Lubricants are also tested in this department. For this purpose a journal $1\frac{3}{16}$ inches in diameter, and running at a speed of 2,200 revolutions per minute is employed. The journal is placed horizontally, and from it depends a pendulum with an adjustable weight. This pendulum is supported on the journal by brass boxes, which can be weighted so as to bear upon the journal with a pressure varying from the weight of the pendulum to 210 pounds by means of a spiral spring. The brass bearing above mentioned has set in it a thermometer, and in testing the lubricant a given quantity of oil is placed in the journal, and the pressure is adjusted as desired."

From time to time other articles than those named above have been added to the lists of things tested, including coal, paints, the zinc and sulphate of copper used in telegraphic service, and also the air taken from passenger cars.

IMPROVEMENTS IN LOCOMOTIVES.

BRIEF reference has been made to leading improvements in the important features of railways which are stationary, including permanent way, stations, signals, culverts, bridges, shops, and terminal facilities. In cost they form much the most expensive portion of railway systems, and yet they yield no direct pecuniary return, in themselves, of material consequence, until they are quickened into earning power by cars and locomotives.

Railway companies spend enormous amounts of money on a variety of indispensable adjuncts for the purpose of extracting cheap labor from coal and water, converted into steam, and for making this operation a possible source of profit by the peculiar nature of the business undertaken by all operating companies, which is the manufacture of transportation, in large or small quantities, to suit the requirements of purchasers. To make coal and water work cheaply and effectively for the furtherance of the desired end it is necessary that a reliable road of an appropriate kind should be constructed and kept in good order, that an abundance of vehicles should be supplied, and that the complicated mechanism of locomotives should be rendered available at all desired times and places.

The locomotive furnishes the motive power of movements made on railways, and few of the existing lines would ever have been constructed if locomotives had not been advanced to a high stage of development.

Relatively speaking, and referring to the condition of all lines in the United States, rather than to those which have done most to improve permanent way, locomotives and cars have been improved much more rapidly and generally than railways. The special excellence or superiority of the railroads of this country, in comparison with those of other countries, consists in rolling stock rather than permanent way. Many details of the latter continue to be, on numerous roads, deplorably deficient, but much has been done to compensate for such deficiencies by the extensive use of superior cars and locomotives.

This country has, to a much greater extent than any other, been

THE LAND OF LOCOMOTIVE IMPROVEMENTS.

A variety of influences have contributed to this important result. They include the fact that more locomotives are used here than in any other country, that nearly every locomotive used on American soil for scores of years has been of home manufacture, that locomotives are one of the few things requiring in production a large amount of skilled labor that has been extensively exported, that special necessities for new designs and alterations or improvements of details have been developed here on account of excessive competition and phenomenally low rates, and that an unusually large number of establishments, including shops of railway companies, as well as works specially devoted to the manufacture of locomotives, have been actively engaged for years, in efforts to devise improvements of varying significance. The effectiveness of these conditions is materially increased by the unusually large number of places or shops at which a practical test of any important new idea can be secured, the magnitude of the work of making locomotives for home and foreign use which goes on annually, subject to the fluctuations between periods of adversity and prosperity, keen rivalry existing between some of the various locomotive works, and the unceasing efforts of skillful designers connected with them and with railway shops to meet new requirements.

LOCOMOTIVE MANUFACTURING ESTABLISHMENTS.

The following list of the locomotive builders in the United States and Canada forms part of the contents of the National Car and Locomotive Builder Supplement, of July, 1887:—

Baldwin Locomotive Works, Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N. Y.
Canadian Locomotive and Engine Company, Kingston, Ont.
Cook Locomotive and Machine Company, Paterson, N. J.
Dickson Manufacturing Company, Scranton, Pa.
Fleming & Sons, St. Johns, N. B.
Grant Locomotive Company, Paterson, N. J.
Grant Iron Works Company, 222 Fremont street, San Francisco.
Hinckley Locomotive Company, Boston, Mass.
Lima Machine Works, Lima, O.
Manchester Locomotive Works, Manchester, N. H.
Mason Machine Company, Taunton, Mass.
Mount Savage Locomotive Works, Mount Savage, Md.
New York Locomotive Works, Rome, N. Y.
North Pacific Iron Works, Seattle, Washington Territory.
Pittsburgh Locomotive and Car Works, Pittsburgh, Pa.
Porter, H. K., & Co., Pittsburgh, Pa.
Rhode Island Locomotive Works, Providence, R. I.
Risdon Iron and Locomotive Works, San Francisco, Cal.
Roanoke Machine Works, Roanoke, Va.
Rogers Locomotive and Machine Works, Paterson, N. J.
Schenectady Locomotive Works, Schenectady, N. Y.
Taunton Locomotive Works, Taunton, Mass.
Tanner & De Laney Engine Company, Richmond, Va.
Virginia Iron Works, Norfolk, Va.
Wyoming Valley Manufacturing Company, Wilkes-Barre, Pa.

The Census Report of 1880 gives the following list of locomotives made by railway companies at their shops during the year ended June 30th, 1880: Central Vermont, 4; Cheshire, 1, Concord, 1; Connecticut and Passumpsic Rivers, 1; Housatonic; 1; Northern of New Hampshire, 2; Old Colony, 5; Baltimore and Ohio, 26; Cleveland, Columbus, Cincinnati and Indianapolis, 5; Cleveland and Pittsburgh, 1; Cumberland and Pennsylvania, 1; Indianapolis, Peru and Chicago, 2; Indianapolis and St. Louis, 2; Michigan Central, 15; New York, Lake Erie and Western, 11; New York, Pennsylvania and Ohio, 3; Philadelphia and Reading, 11; Philadelphia, Wilmington and Baltimore, 1; Pittsburgh, Fort Wayne and Chicago, 17; Syracuse, Binghamton and New York, 1; Utica, Chenango and Susquehanna Valley, 1; Chicago, St. Louis and New Orleans, 2; Louisville and Nashville, 10; Seaboard and Roanoke, 3; South Carolina, 7; Washington City, Virginia Midland and Great Southern, 1; Chicago, Burlington and Quincy, 4; Chicago and North-western, 37; Wabash, St. Louis and Pacific, 8.

As many companies made no returns whatever relating to their manufacture of rolling stock to the Census Bureau, it is probable that the above list conveys an inadequate idea of the number of locomotives made in railway shops. The companies which have made locomotives since 1880, embodying important changes or improvements that are not mentioned above, include the Pennsylvania, Lehigh Valley, Chicago, Burlington and Quincy, and Central Pacific.

The necessities developed in the anthracite coal regions of Pennsylvania furnished one of the strongest incentives to notable improvements. They stimulated efforts to perfect the system of coupling numerous driving wheels, by which a marked increase in power was obtained, some of these wheels being without flanges, which finally resulted in the construction of locomotives of the mogul and consolidated types. They led to the continuous experiments which secured the complete success of the anthracite coal-burning engines. They incited efforts to secure a coal-dirt-burning engine, which resulted in the production of engines of the Wootten type. They increased the demand for powerful fast passenger engines, intended for use in hauling heavy trains over steep grades, which requirement the Strong locomotive, manufactured at Lehigh Valley shops, is specially intended to meet. The work done, or plans conceived in, Lehigh Valley and Philadelphia and Reading shops, in connection with the improvements referred to above, was of great importance, and the Lehigh Valley is entitled to special credit for achievements connected with the development of the consolidation and Strong locomotives, while men connected at various periods with the Philadelphia and Reading can point with just pride to early successful anthracite coal-burning engines and the Wootten locomotive.

The Pennsylvania Railroad, with its enormous and varied traffic, great variety of grades and classes of business, the magnitude of its coal-carrying labors, which involve movements similar to those necessitated in the anthracite regions, and the completeness of its shop facilities at Altoona, has done much to promote substantial improvements in locomotive construction. The other trunk lines, some of the New England roads, some roads which had peculiar requirements, such as those existing on the heavy mountain grades of the Central Pacific, have made corresponding efforts to provide for their special needs. In several of the roads radiating from Chicago great attention has also been paid to locomotive improvements of various kinds.

The advances made include first, a great increase in the number of locomotives; second, a material increase in styles, or classes, for the purpose of securing special adaptation to different uses; third, a notable increase in the size and capacity of freight locomotives; fourth, an increase in the speed of passenger locomotives; and fifth, numerous improvements in details of construction.

INCREASE IN NUMBER OF LOCOMOTIVES.

In the number of locomotives per mile of road there is a great difference between the railways of different classes and sections, which corresponds, to a considerable extent, to differences in volume of traffic. The general tendency is towards an increase. A writer who had investigated this subject in 1885 reported that at that time the four trunk lines, the Reading, and the Boston and Albany had from 46 to 66 locomotives per 100 miles of railroad; the other lines from 13 to 26.

In September, 1887, the number of locomotives of representative roads of various classes was reported to be as follows:—

	Miles.	Locomotives.
New England Roads.		
Boston and Albany	372	245
New York and New England	471	147
Boston and Maine	594	233
New York, New Haven and Hartford	265	132
Old Colony	475	133
Central Vermont	583	122
Maine Central	535	86
Trunk Lines.		
Baltimore and Ohio	1,805	685
New York Central and Hudson River	983	661
New York, Lake Erie and Western	1,083	460
Pennsylvania Railroad Company's roads east of Pittsburgh and Erie (general divisions)	3,561	1,665
Anthracite Coal Roads.		
Lehigh Valley	582	426
Philadelphia and Reading	1,586	606
Southern Roads.		
Central of Georgia	1,115	148
East Tennesse, Virginia and Georgia	1,098	155
Louisville and Nashville	2,344	391
Mobile and Ohio	680	83
Richmond and Danville roads	2,324	262
Central Western Roads.		
Pittsburgh, Fort Wayne and Chicago	468	288
Pittsburgh, Cincinnati and St. Louis	954	263
Chicago, St. Louis and Pittsburgh	583	190
Cleveland, Columbus, Cincinnati and Indianapolis and St. Louis railways and Dayton and Ohio	788	233
Lake Shore and Michigan Southern	1,340	535
Michigan Central	1,563	396
New York, Chicago and St. Louis	524	108
Ohio and Mississippi	622	115
Roads Radiating from Chicago in Western, North-western, South-western, or Southern Directions.		
Chicago, Burlington and Quincy	2,080	463
Chicago, Milwaukee and St. Paul	5,131	626
Chicago, Rock Island and Pacific	1,381	336
Chicago and Alton	849	228
Chicago and North-western	4,019	705
Illinois Central	2,148	368
Pacific Roads.		
Northern Pacific	2,800	386
Union Pacific	4,482	500
South-western Roads.		
Atchison, Topeka and Santa Fe	2,776	380
Missouri Pacific	1,346	288
St. Louis and San Francisco	943	103
Texas and Pacific	1,487	175

The locomotive capacity of the country has increased with wonderful rapidity, the gains being not only in the number in use, but in the average working of many of the new locomotives. Their number is shown by the following figures, compiled from reports in Poor's Railway Manual: Number of locomotives belonging to railway companies in the United States in 1876, 15,618; in 1877, 15,911; in 1879, 17,084; in 1880, 17,949; in 1881, 20,116; in 1882, 22,114; in 1883, 23,623; in 1884, 24,587; in 1885, 25,937; in 1886, 26,415. The number made annually is considerably greater than the annual increase represented by the above figures. One of the estimates of their average life is from fifteen to twenty years, and a considerable amount of new construction is required, annually, to supply substitutes for the old engines that are finally broke up.

During the census year ending June 30th, 1880, the total number of locomotives reported was 17,412, and their geographical distribution was as follows:—

Geographical group.	Number of locomotives.
I. Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut	1,733
II. New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, and District of Columbia	8,886
III. Virginia, West Virginia, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, and South Carolina	1,771
IV. Illinois, Iowa, Wisconsin, Missouri, and Minnesota	3,496
V. Louisiana, Arkansas, and Indian Territory	82
VI. Dakota, Nebraska, Kansas, Texas, New Mexico, Colorado, Wyoming, Montana, Idaho, Utah, Arizona, California, Nevada, Oregon, and Washington	1,444
Total	17,412

INCREASE OF CLASSES OF LOCOMOTIVES.

In the earlier days of railroading the varieties of locomotives, as well as their number, were limited. Many of those in use were not designed for special service, being intended for passenger as well as freight service, or for hauling mixed trains, made up in part of passenger cars and part of freight cars. Engines of the same class were usually employed in switching service. In the progress of development a variety of different requirements have arisen, each of which, on a number of lines, is of sufficient consequence to render it desirable and economical that locomotives specially adapted to each of the various classes of work to be done should be procured, and new construction has, to a considerable extent, responded to this state of affairs. On a small farm the horse of all work alternately pulls the plow, the wagon, and the carriage, but in communities where there are diversified demands for the equine race may be found the dwarfish pony, the gigantic draft horse, the average car horse, the serviceable carriage horse, the fast trotter, and the fleet racer. Similar advances have been made in connection with the introduction and extensive use of distinct varieties of locomotives, and about or soon after 1870 these diversifications began to materially increase. One of the directions was in the construction of economical switching engines, in which service many locomotives are employed. Others were in the establishment of broad lines of distinction between passenger engines and freight engines; in improvements intended to have a special effect on the kinds or quantities of fuel used; in the various styles of passenger engines, with reference to speed or number of cars to be hauled, and in different classes of freight engines, with reference to the weight of trains, speed, grades, curves, nature of traffic, and variations in the characteristics of different divisions of many lines. Some manufacturers have made a specialty of light locomotives, and other establishments are engaged principally in making locomotives to be used in mines, hauling logs, &c. The net result of a response to the varied requirements is the production of many more kinds of locomotives, if allowance is made for the variations in size and capacity of different classes, than could formerly be procured. At the same time, there is a large amount of railway mileage in the United States on which traffic is so light that it is a matter of comparatively small importance whether engines of more than one class should be used on it, and its requirements may presumably be best served by locomotives of the "American" type, intended either for freight or passenger service, or for hauling mixed trains.

An indication of the extent to which varieties of locomotives have been introduced is furnished by the fact that the catalogue of the Baldwin Locomotive Works in 1881 illustrates and describes the following classes, of which a number of different sizes, amounting in the aggregate to more than five hundred, could be procured, viz.: Light passenger locomotives, "American" type; passenger and freight locomotives, "American" type; fast passenger locomotives; freight and mixed traffic locomotives, "10-wheeled" type; light freight locomotives, "mogul" type; freight locomotives, "mogul" type; freight locomotives, "consolidation" type; switching locomotives, 4-wheels-connected; switching or local service locomotives, 4-wheels-connected, and leading pony truck; switching or local service locomotives, "Forney" type, 4-wheels-connected, and trailing pony truck; switching or local service locomotives, "double-ender" type; local passenger locomotives, "double-ender" type; switching or freight locomotives, 6-wheels-connected; switching or freight locomotives, 6-wheels-connected, and trailing pony truck; switching or freight locomotives, 6-wheels-connected, and trailing 4-wheeled truck; inclosed switching locomotives.

For general railway purposes the leading classifications are passenger locomotives, freight locomotives, and switching engines. A French engineer of motive power, who visited the United States in 1885, for the purpose of investigating the locomotive service of this country, reported that "each company has four principal types, one with two axles coupled for passenger trains, one with three axles connected for light freight trains, one with four axles connected for heavy freight trains, and one for switching. These types do not differ greatly on different roads, and a great many parts are common to all the types, considerably reducing the number of spare pieces to be kept in stock." This general rule is subject to the qualification that some companies have more and some less than four principal types, and the relative number of engines of the American type has been rapidly decreasing during late years.

INCREASED SIZE AND CAPACITY OF FREIGHT LOCOMOTIVES.

A NOTICEABLE feature of the modern transportation development of this country is a much more rapid increase in the number of freight cars than in the number of passenger cars.

There was also, necessarily, a much more rapid increase of the requirements for additional motive power for moving freight, than of the demands for additional passenger locomotives. One of the outgrowths of the prevailing needs was a great increase in the capacity of many of the new freight locomotives, as well as in their number.

A vital change promoted by the use of the engines of increased size and capacity hinged on the fact that the useful effect of the labors of locomotive engineers and firemen employed was greatly increased, sometimes to the extent of from fifty to more than one hundred per cent., and there was a notable gain in the weight of the average train load moved without a material additional expense for labor being incurred.

The nature of such gains is forcibly described in the following extract from remarks made by O. Chanute at a meeting of the American Society of Civil Engineers held in January, 1883:—

"The practice on the Erie road makes it very clear and apparent that the heavy engines are the economical ones to use. In 1874 the average train upon the Erie Railway was about twenty-two cars. The road was then mainly equipped with 'American' engines of eight wheels (of which four are drivers) on the various divisions. On the Buffalo division and on the Western division the average load was from 17 to 19 cars, and the average train load, including the empties, was, I think, about 106 tons. In 1876 the road began to put on the consolidation engines. These were carefully limited to an average of 11,000 pounds per wheel, which was somewhat less than the weight then existing upon the 'American' engine. And I would say with regard to the wear of rails that we have not yet been able to detect any more wear from the wheels of those consolidation engines than from the 'American' engines which they displaced. The effect of putting these engines has been, I believe, to increase the average train to about 38 cars, and the freight per train to about 228 tons instead of 106 tons. There were, at the beginning, some difficulties apprehended, chiefly from the breaking of trains in two, the pulling out of draw-heads, breaking of links and pins, and similar accidents likely to detain the traffic. It was, therefore, determined to change and to increase the strength of the draw attachments to the car. A stronger draw-head spring was substituted. The draw-head arms were more firmly fastened to the main-sills of the car, the draw-head was increased in strength, the pin and the link were also increased in size, and then pains were taken to prevent, as far as possible, the breaking of trains in two, which, railroad men all know, causes the largest number of minor accidents occurring on railroads. These precautions were found to produce an entire success, and although the trains were about double the former length, the accidents were actually diminished in number; and not only was the useful train load increased, but the expenses of doing the freight traffic were diminished from 0.958 cents a ton a mile to 0.526 cents a ton a mile, which latter cost the operating accounts show for last year."

The increase of the average train load which occurred on the

Erie railroad was fully equaled by corresponding developments on a number of other lines. Elaborate statistics bearing on this subject have been published, and they afford one of the most important indications of the extent to which economy of movement has been promoted, as it costs comparatively little more to move a heavy train than a light one. A condensed statement of the results on a few typical lines will illustrate an extensive movement:—

AVERAGE TRAIN LOAD IN TONS.

	In 1875.	In 1880.	In 1885.
Lake Shore and Michigan Southern	168	252	254
New York Central	169	219	204
New York, Lake Erie and Western	134	211	227
Pennsylvania	128	184	209
Boston and Albany	82	97	109
Delaware, Lackawanna and Western	83	..	107
Pittsburgh, Fort Wayne and Chicago	96	125	138
Pittsburgh, Cincinnati and St. Louis	98	166	182
Chicago and Alton	124	177	184

One of the advantages claimed for heavy modern freight engines is that their construction has been simplified, so that, in comparison with former practice, they need fewer repairs, being kept more steadily at work, and losing less time in shops.

THE LARGEST AND MOST POWERFUL LOCOMOTIVES

ever built in this country up to 1885 were "El Gobenador," constructed by the Central Pacific Railroad at its shops at Sacramento, California, under the direction of Mr. A. J. Stevens, general master mechanic of the Central Pacific, for service on the Sierra Nevada mountains, and Decapod, or 12-wheeled locomotives, built at the Baldwin works, one of which was for the Dom Pedro II Railroad of Brazil, and another for the Northern Pacific, for service on one of its mountain divisions. It was believed, in 1884, that the El Gobenador was the most powerful locomotive ever built up to that time in the world. Its leading dimensions were as follows:—

Diameter of cylinders	21 inches.
Stroke of cylinders	36 inches.
Diameter of driving-wheels	57 inches.
Driving-wheel base	19 feet 7 inches.
Total length, engine and tender	65 feet 5 inches.
Total weight of engine, ready for service	146,000 pounds.
Weight of tender, without coal or water	50,650 pounds.
Weight of water in tank (3,600 gallons)	30,000 pounds.
Weight of coal	10,000 pounds.
Total weight, engine and tender, fully equipped	226,650 pounds.
Weight on drivers	128,000 pounds.

The following are the principal dimensions of the Decapod locomotive built in 1885 for the Dom Pedro II Railroad of Brazil:—

Actual weight, in working order, exclusive of tender	144,000 pounds.
Actual weight on driving-wheels	128,000 pounds.
Estimated weight of tender, including fuel and water	80,000 pounds.
Estimated weight of locomotive and tender, in working order	224,000 pounds.
Cylinders	22×26 inches.
Driving-wheels, five pairs coupled	45 inches diameter.
Total wheel-base	24 feet 4 inches.
Driving wheel-base	17 feet 0 inches.
Rigid wheel-base	12 feet 8 inches.
Boiler of iron, ⅝ inch thick	64 inches diameter.
Height of centre line of boiler above rail	7 feet.
Fire-box	10 feet 1 inch long by 39½ inches wide inside.
Tubes	268 in number, 2 inches diameter, 12 feet 9½ inches long.
Heating surface of fire-box	160 square feet.
Heating surface of flues	1,783 square feet.
Total heating surface	1,943 square feet.
Tank capacity	3,500 gallons.

MOGUL AND CONSOLIDATION LOCOMOTIVES

had been manufactured before 1870, but there was a light demand for them for some years, as they were originally devised to meet special exigencies arising in the anthracite coal regions of Pennsylvania, but about the middle of the eighth decade their numbers increased materially, and a few years later, especially after 1880, their increase became rapid.

During a portion of the eighth decade, and since that time, to a considerable extent, the views of a number of experts in relation to the respective merits of mogul and consolidation engines, with reference to their applicability to particular lines, on which powerful freight locomotives were considered desirable differed materially, some preferring the former and some the latter, but a decided preference for one of these types has been manifested in many quarters, and it is to the performances of these locomotives, especially those of the consolidation type, with its various modifications, perhaps, more than to any other single influence, except the introduction of steel rails, that this country and the world are indebted for the establishment of the cheapest known system of overland freight movement.

Of the most powerful of modern American locomotives, it has recently been stated that they could convert 3,000 gallons of water into steam in an hour.

The catalogue of the Baldwin Locomotive Works for 1881 describes four sizes of locomotives of the mogul type which had a capacity of hauling on a level, respectively, loads, of cars and lading, of 1,740, 1,835, 1,920, and 2,000 tons of 2,240 pounds. The heaviest of these locomotives could haul a load of 880 tons on a grade per mile of 26.4 feet; 520 tons on a grade of 52.8 feet; 360 tons on a grade of 79.2 feet; 270 tons on a grade of 105.6 feet; 215 tons on a grade of 132 feet, and 170 tons on a grade of 158.4 feet.

Two freight locomotives of the consolidation type had a capacity of hauling on a level, respectively, loads of 2,560 and 2,740 tons of 2,240 pounds. The heaviest of these could haul 1,205 tons on a grade per mile of 26.4 feet; 720 tons on a grade of 52.8 feet; 495 tons on a grade of 495 feet; 370 tons on a grade of 105.6 feet; 290 tons on a grade of 132 feet, and 235 tons on a grade of 158.4 feet.

Detailed reports of actual performances of engines of the classes referred to, furnished by railway officials in various sections of the country, are published, which substantially show that the capacity claimed is not exaggerated. In one instance mention is made of a train consisting of 100 cars, weighing 2,201 tons of 2,240 pounds each, including the weight of engine, tender, and fuel, hauled over a road, containing a number of sharp curves, by a consolidation engine. Sundry other statements furnish evidence of corresponding capacity in ascending steep grades.

Of the performances of the heaviest locomotive of the consolidation type, built at the Baldwin Locomotive Works previous to 1881, constructed for an extension of the Atchison, Topeka and Santa Fe, the catalogue says: "This locomotive was built for working a temporary switchback track (used during the construction of a tunnel) crossing the Rocky mountains, with maximum grades of 6 in 100. Over these grades the engine hauled its loaded tender (40,000 pounds) and 9 loaded cars (each 43,000 pounds); total load, exclusive of its own weight, 541,000 pounds. On a grade of 2 per cent. it hauled a train weighing 965,000 pounds, and on one of 3½ per cent., 517,000 pounds. Curves of 16 degrees occurred on the switchback track, but not in combination with the 6 per cent. grade."

Of the performances of consolidation engines on portions of the Pennsylvania system, Mr. Dredge, writing for Engineering in 1876, said:—

"The type of engine we have been describing does some very heavy work on the Pennsylvania Railroad. Thus on the Philadelphia and Columbia division, where the maximum grade going eastward is 40 feet to the mile, or 1 in 132, the load, taken at a speed of 15 miles per hour, consists of a train of 35 loaded cars weighing 735 tons, exclusive of the engine; while going westward over the same division, a maximum grade of 49 feet per mile, or 1 in 107.8 to be surmounted, and the load is then 30 loaded cars weighing 630 tons. The consumption of fuel on this part of the road averages 4.2 pounds per mile per car hauled. On the Columbia and Harrisburg division there is a short grade of 30 feet per mile, or 1 in 176 going eastward, and a short grade of 37 feet per mile or 1 in 142.7 going westward, and on this section the loads in the two directions are 70 cars weighing 1,470 tons, and 65 cars weighing 1,365 tons respectively, the consumption of fuel averaging 2.7 pounds per car mile. On the Erie and Langdon's division the maximum gradient going eastward is 71 feet per mile, or 1 in 74.4, and up this gradient the engines haul 24 loaded cars weighing 504 tons. On the Renovo and Jersey Shore section going eastward there is a gradient of 26 feet per mile, or 1 in 203 for about four miles, the remainder of the line being practically level, and on this division the load for the engines consists of 80 loaded cars weighing 1,680 tons, with a consumption of 2.7 per car per mile. Finally, on the Susquehanna division, which is about level, the load going eastward consists of 85 loaded cars weighing 1,785 tons, this load being frequently taken at a speed of 25 miles per hour, and the fuel consumption being 2.5 pounds per car per mile. These performances are of much interest, the loads being unlike anything hauled in England."

At a later period improved types of consolidation engines were built for the service of the Pennsylvania Railroad, principally at its own shops at Altoona, which possessed considerably greater power than the engines referred to above.

A good illustration of the prevailing modern tendencies is furnished by the following details of this change in the type of consolidation engines used on the Pennsylvania Railroad, which was made in 1886, the first of the new sample engines having been made at the Altoona shops in 1885.

The consolidation locomotive of 1876, designated class I, was the heaviest standard freight locomotive used on the road at that time and for some years later. The new class, adopted in 1886, is designated class R. Some of the most notable changes in weight and general dimensions, which presumably represent corresponding changes in power or effectiveness, were as follows:—

	Class I, 1876.	Class R, 1886.
Total weight of locomotive in working order	91,640 lbs.	114,625 lbs.
Total weight on driving-wheels	79,400 lbs.	100,600 lbs.
Number of tubes in boiler	138	183
Total heating surface	1,258 sq. ft.	1,731 sq. ft.
Weight of tender, loaded	55,760 lbs.	57,800 lbs.

The water capacity of the tank of the tender of each engine is 3,000 gallons, and the coal capacity of the tender or fuel-bin of each is 8,000 pounds. The gains, in effectiveness, in addition to weight, &c., include a higher boiler pressure.

THE RELATIVE POWER OF LEADING TYPICAL LOCOMOTIVES,

as shown by the maximum working loads in tons of 2,000 pounds on a level road, uncomplicated by curvature or fluctuations of velocity, has been estimated as follows: American light, 1,198 tons; American standard, 1,442 tons; light 10-wheeled locomotives, 1,690 tons; average 10-wheeled and light mogul, 1,936 tons; standard 10-wheeled and heavy mogul, 2,183 tons; light consolidation locomotives, 2,430 tons; average consolidation engines, 2,675 tons; standard heavy consolidation engines, 2,920 tons; extra heavy mastodon locomotives, 3,163 tons.

The capacity diminishes with an increase of grade, until even the heaviest of the locomotives can haul comparatively light loads over some of the heavy mountain grades of this country. The standard load of freight varies greatly on different roads, and on different divisions of the same road, if there is a marked variation in the characteristics of its divisions. One of the highest achievements of the ninth decade, on favorable grades, is to haul standard loads of about 1,500 tons, or 3,000,000 pounds of freight, exclusive of weight of engine, tender, and cars, and standard loads vary from these figures downward to a few hundred tons.

ECONOMIC EFFECT OF SUBSTITUTION OF HEAVY FOR LIGHT ENGINES.

The proceedings of the road masters' meeting of the Atlantic and Great Western, held at Meadville, Pennsylvania, on November 14th, 1878, embrace a statement of the advantages that road would derive from the substitution of mogul and consolidation locomotives for lighter engines, presented in a series of questions and answers by Charles Latimer, chief engineer, which include the following:—

"Q. How many common engines do we now use?

A. Upwards of one hundred.

Q. How many moguls will do the same work?

A. Two-thirds of one hundred, or sixty-seven.

Q. How many consolidations will do the same work?

A. $\frac{100}{182}$ of one hundred, or fifty-five.

Q. How many engines will we thus save?

A. Thirty-three engines by using moguls, or forty-five engines by using consolidations.

Q. What amount of money would thus be saved in capital invested?

A. 100 engines of present type at $7,500 each, cost $750,000; 67 engines of mogul type at $8,100 each, cost $542,700; 55 engines of consolidation type at $9,750 each, cost $536,250; saving by using moguls, $207,300; saving by using consolidations, $213,750.

Q. What amount would be saved in engine repairs?

A. $51,755 annually.

Q. What amount would be saved in train wages?

A. $144,940.

Q. What amount would be saved in fuel and oil?

A. $46,756.

Q. Since fewer engines will be used and less weight in the aggregate pass over the line, how much would be saved in maintenance of way?

A. $51,726.

Q. How much would be saved in engine houses?

A. Only from one-half to two-thirds of the present amount of room will be required."

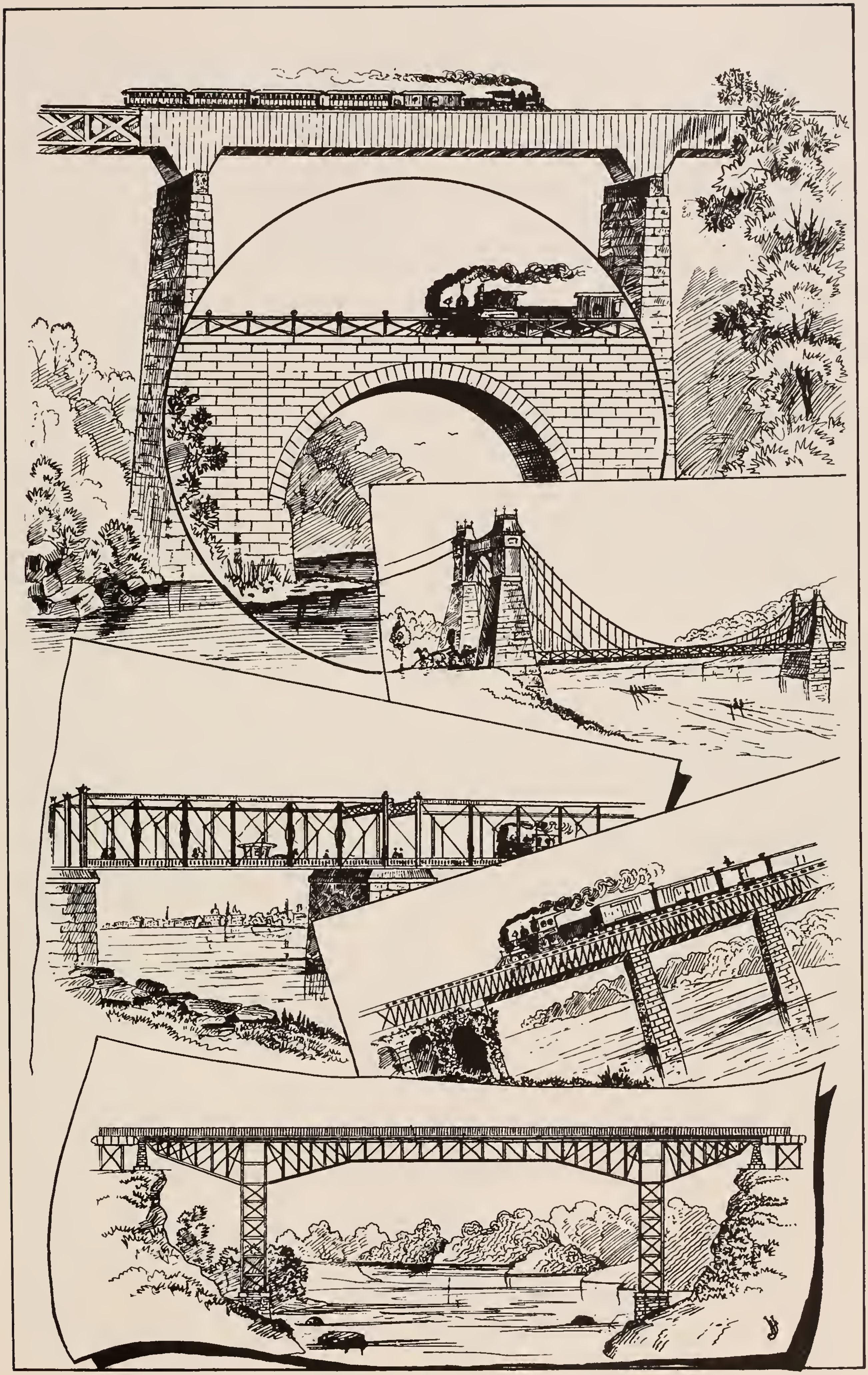
CONTINUED USE OF MANY OLD-STYLE LOCOMOTIVES.

As locomotives are wonderfully durable machines, in view of the large amount of hard service they perform, a change in the character of the engines used on any road can only be made gradually, old types continuing in service until they are worn out, and new types being purchased or manufactured only when replacements or additions to equipment become necessary. The life of a locomotive may be greatly prolonged by limiting the amount of its annual service, and in a few exceptional cases their existence as working machines extended over a period of about half a century. Longevity from twenty to thirty years is not uncommon, but in the best modern practice a considerable percentage of locomotives are condemned before they reach their fifteenth year. Of some of the old locomotives which are still in comparatively good condition it is reported that they are too light to be efficient in hauling the heavy trains now handled on the roads to which they belong, and a number of companies have manifested a disposition to hasten the substitution of relatively heavy for light engines as much as possible. Meanwhile much of the freight service of the present day is done by engines made during the eighth decade, or before that time, when some of the conditions which now favor and demand relatively heavy and powerful locomotives did not exist.

INCREASED SPEED OF PASSENGER LOCOMOTIVES.

CONSIDERABLY more attention was formerly paid to the improvement of freight locomotives than to material changes in the construction of passenger locomotives. Slight modifications of the American type of engines supplied for more than a score of years the requirements of nearly all companies. Shortly before the beginning of the ninth decade, however, and to an increasing extent since that time, demands became urgent for passenger locomotives which could draw comparatively heavy loads at higher rates of speed than had previously been common. Exceptionally energetic efforts were made to increase the speed of passenger locomotives running on the roads between New York and Philadelphia, Philadelphia and Washington, New York and Buffalo, Buffalo and Chicago, and some New England roads, as well as on railways of a few other sections.

One of the results of these efforts was the construction of a



VARIOUS STYLES OF AMERICAN RAILWAY BRIDGES.

number of notable styles of locomotives, for each of which a speed of at least sixty miles per hour, under favorable conditions, is claimed, with ability to make considerably faster time for short distances, under exceptionally favorable circumstances.

Some of the most important of these improvements are represented by new or modified types of passenger locomotives manufactured at the Altoona shops for service on various portions of the Pennsylvania Railroad system; at the Baldwin works or Reading shops for the Bound Brook route; engines made for service on the New York Central and Hudson River; engines made at the Rogers works for the New York, West Shore and Buffalo; engines made at the Rhode Island Locomotive Works for service on the New York, Providence and Boston road; and the Strong locomotive made at the Lehigh Valley shops.

It is obvious that there is a great difference in the possible performances of a locomotive under the most favorable conditions, and the speed that can be maintained with sufficient steadiness to furnish a basis for regular schedules. On portions of all American roads of considerable length there are serious obstacles to be encountered, such as those arising from heavy grades, sharp curves, weak bridges, defective track, or grade crossings, which make it easy to traverse some sections more rapidly than others; and unpropitious weather or crowded condition of tracks materially increase the obstacles to high speed along entire lines. Therefore, locomotives that maintain with approximate regularity any given schedule time could do much better under exceptionably favorable circumstances.

RECORDS OF AVERAGE DAILY PERFORMANCES

include the following: The Railroad Gazette, of February 11th, 1887, says:—

"The fastest train on the New York Central runs from New York to Buffalo, 440 miles, in 10 hours and 45 minutes, or at the rate of 40.93 miles per hour. This can be done because the grades are remarkably favorable, and the stopping stations average no less than 110 miles apart. The Pennsylvania runs the limited express from Jersey City to Pittsburgh, 443 miles, in 11 hours 17 minutes, corresponding to a speed of 39.27 miles per hour, the average distance between stoppages being 110¾ miles. The speed is fully 1½ miles slower than on the New York Central, showing the effects of the more unfavorable grades and curves. On a straighter track, the Pennsylvania attains a considerably higher speed, the fastest train between Jersey City and Washington covering the distance, 226.7 miles, in 5 hours 2 minutes, which gives a speed of 45.04 miles per hour. The distance from New York to Boston by the Boston and Albany route is 234 miles, and notwithstanding the keen competition and great through travel, the speed is only 39 miles per hour by the fastest train on this route, which covers the distance in 6 hours.

The fastest run in regular work between any two stopping points give a speed of slightly over 53 miles per hour. Higher rates of speed have been obtained when making up time, but at present the average speed while in motion seems to be considerably under 60 miles per hour. Many trains doubtless fully attain that speed on a large portion of the run, but the time occupied in getting up speed after starting and slackening before stopping reduces the average speed to about 53 miles per hour."

A number of accounts of notable performances of locomotives over considerable distances have appeared. Detailed reports were published of a

FAST RUN MADE ON THE NEW YORK, WEST SHORE AND BUFFALO,

on July 10th, 1885, which was claimed to be the fastest run, for the distance, ever made up to that time in this country. W. W. Wheatley, chief train dispatcher, in describing it, said:—

"Several miles were made in 43 seconds, while the greater part of the run was made at a speed averaging 45 to 48 seconds per mile. This is at the rate of 70 to 83 miles per hour. If you will analyze the run, you will be surprised to find that their assertions must be true, and that the speed was maintained throughout the whole of the run. Please note the run from East Buffalo to Genesee Junction, 61 miles. Starting from a dead stop at East Buffalo, they came to a stop at Genesee Junction within exactly 56 minutes.

The run from Alabama to Genesee Junction, 36.3 miles, was made in precisely 30 minutes.

The run from East Buffalo to Newark, 93.4 miles, was made in 97 minutes. There are two stoppages to be deducted from this, one of 7 minutes at Genesee Junction for water and oiling engine, and a full stop at Red Creek for the New York, Lake Erie and Western grade crossing, for which we deduct 2 minutes, making the actual running time 88 minutes.

At Newark the train stopped 9 minutes to change engines.

The conditions are not so favorable for fast running east of Newark as west, but the distance from Newark to Frankfort was covered in 134 minutes; distance, 108.3 miles. There were six stoppages in this distance, aggregating a delay of 17 minutes, which makes the actual running time 117 minutes.

The whole run from East Buffalo to Frankfort, 202 miles, was made in 4 hours, or 240 minutes. Deducting total detentions of 35 minutes, the actual running time was 205 minutes."

The train was composed of an engine and tender, a baggage car, and the official cars, having an aggregate weight of 155 tons, a little more than one-half of which consisted of the weight of the engine and tender. The engine used on the north end of the division was a class A anthracite locomotive, weighing 96,000 pounds, which increased the weight given above to the extent of 1,500, while on the other portion of the run a class B bituminous coal engine, weighing 94,500 pounds, was used. The weight of the tender, with two-thirds load of coal and water, was 62,800 pounds. These engines were of a type designed by the late Howard Fry for the West Shore, and made at the Rogers Locomotive Works. One of such engines, which was on exhibition at the Chicago Exposition of Railway Appliances in 1883, attracted much attention there, and was regarded by some observers as an embodiment of all the latest improvements.

FAST RUN ON THE NEW YORK CENTRAL.

Of a remarkable run made at a later date on the New York Central the New York Sun, in an article printed in November, 1887, says:—

"The heaviest engines that go over the New York Central road weigh 74 tons. This includes the tender. Mr. Buchanan, the superintendent of motive power, says the largest wheels he is now putting on are 5 feet 8 inches. Six-feet drivers were used, but the reduction was made to get more power.

Mr. Buchanan was asked if it is possible to make a mile in 38 seconds. He said that depended upon all the conditions being exactly right. He said he had made, in observation locomotive 522, three miles in succession in 40, 41, and 42 seconds respectively. The following schedule was given as the fastest time ever made for the distance, 149 miles in 136 minutes. It is the running time made by newspaper special train No. 11, between Syracuse and Buffalo, on August 8th, 1886, drawn by engine 541; John W. Cool, engineer:—

	Intermediate distance.	Time between stations.	Rate of speed per hour.
Syracuse	....	....	....
Oswego Junction	3.00	3.30	54.54
Warner's	6.34	6.00	63.40
Jordan	7.71	7.00	66.08
Weedsport	4.34	3.50	74.40
Port Byron	2.37	3.00	67.40
Savannah	7.00	6.15	68.29
Clyde	6.20	5.25	70.85
Lyons	7.37	6.50	68.03
Palmyra	12.51	10.45	71.82
Fairport	12.80	10.25	74.93
Rochester	10.09	9.00	67.27
Rochester (stopped for water).			
Coldwater	6.16	5.35	69.08
Bergen	11.55	9.40	73.72
Byron	7.72	6.55	70.72
Batavia	6.59	7.50	52.72
Crittenden	15.77	13.30	71.14
Gainesville	9.59	8 30	69.32
Buffalo (E street)	10.59	12.00	52.95

There was a slow up at Batavia.

Average speed, Syracuse to Rochester....67.27

Average speed, Rochester to Buffalo....63.72

Average speed, Syracuse to Buffalo....65.60

The standard passenger locomotives on the New York Central and Hudson River Railroad in use about 1884, known then as class A, were intended for the use of bituminous coal as a fuel, and had exceptionally effective smoke-preventing devices. They represented the most advanced developments of the designs of Mr. Buchanan, superintendent of motive power on that road, at that time. A description published in the American Journal of Railway Appliances includes the following statements:—

"The engine has cylinders 17×24 inches, and the driving wheels are 70 inches diameter outside of tires, the tires being 3½ inches diameter. The boiler is designed to carry steam at 145 pounds pressure. With a mean effective pressure of 120 pounds, the engine is capable of exerting a force of 11,890 pounds to turn the drivers. As the total weight of the engine in working order is 82,760 pounds, and as 52,160 pounds rest on the driving wheels, the whole force stated may be used in starting a train without trouble from slipping.

Throughout the whole of the parts of engine and boilers indications are everywhere apparent of well-considered designing and painstaking development of details. Ample wearing surface is provided for all the rubbing parts. A liberal margin of strength is given to all parts subjected to working strains, yet the material is judiciously placed to secure as much lightness as possible consistent with the required strength, and all parts are put together in such a way that they can easily be taken apart for repairs, or reached when repairs are necessary. This is a very important feature, and one that has very great influence on the cost of repairs when an engine is in service; and it is also a matter which is too often neglected by locomotive designers.

The valve motion is of the ordinary shifting-link type, and it is designed so that the distribution of steam is remarkably uniform from full stroke up to 6 inches cut-off. The steam ports are 1¼×15½ inches, and the exhaust port is 2½ inches wide. The valves have ⅞ outside and $\frac{3}{32}$-inch inside lap, set with $\frac{1}{16}$ lead in full gear, and the greatest valve travel is 5 inches, being equal to the throw of eccentric. The main connecting rod is 7 feet 9 inches long, the length of the eccentric rods is 47⅝ inches, and the links are slotted to a radius of 63⅝ inches. Strap ends are used on connecting and side rods. A plain steel cross-head working in four-bar guides is employed. The centres of the cylinders are 6 feet 1 inch apart, and the driving wheels tram 8 feet 6 inches between axle centres, that length of side rods being required. The driving-axle journals are 7 inches diameter and 8 inches long, the main crank-pin bearings are 4×4 inches, and the side rod bearings 3¼×3¼ inches.

But the most noteworthy parts of this locomotive are the boiler and fire-box. This combination of boiler and fire-box can hardly be regarded as a novelty, for the pattern has been in use for several years, but its features and performance are not nearly so well known as they deserve to be. The boiler is of the wagon-top variety, being 50 inches diameter at the smallest ring, and the wagon top is raised 11 inches. Iron ⅜-inch thick is used throughout the shell, the horizontal seams have a single lap welt and are double riveted, and the circumferential seams have single lap, single riveted. There are 198 steel tubes 2 inches diameter and 11 feet 8 inches long.

The inside fire-box is of steel, the side, front, and back sheets being $\frac{5}{16}$-inch thick, the crown sheet ⅜-inch thick, and the tube plates ½-inch thick. Beginning at a point in the front sheet of the fire-box, level with the bottom of the barrel of the boiler, a water table passes diagonally across the fire-box to a point above the fire-box door, dividing the fire-box into two parts. The only communication between the part of the fire-box where the grates are, and the part connecting with the tubes, is an oval opening resembling an ordinary fire-door, which is made in the middle of the water table. Through this opening all the gases of combustion must pass in their way to the tubes, and the upper portion of the fire-box acts as a combustion chamber to complete the chemical combination of the products of the fire. This arrangement in itself is a good smoke-preventing device, for it tends to promote the admixture of the gases which results in the perfect combustion that produces no smoke, but Mr. Buchanan has added special means for supplying air above the fire, which makes this fire-box phenomenal for the manner in which it burns the softest bituminous coal without producing smoke. Superheated steam is used to induce jets of air upon the fire through four openings made in the front and four in the back of the fire-box. Steam is led from the dome through an iron pipe which passes inside the fire-box to a coil which rests on top of the water table. Here the steam is superheated and afterward passes on to the jets mentioned. These jets act as air injectors, and propel a considerable volume of air into the fire-box, imparting to it a portion of the heat of the superheated steam, thereby tending to keep up the temperature of the fire-box.

The crown sheet is stayed with girder stays. There are 18 square feet of grate area, the heating surface of the fire-box is 153.12 square feet, heating surface of tubes 1,200 square feet, the total heating surface being 1,353.12 square feet.

The engine has an extended front end and open stack; this, in combination with the style of fire-box, providing a thorough preventive against spark throwing. The base of the smoke stack is conical, and the exhaust pipes are brought up and come together gradually, ending in a single nozzle 4½ inches diameter. Mr. Buchanan believes that the single nozzle exhausting the steam centrally into a conical-shaped stack, acts like an ejector in inducing draft, and that the required draft can be maintained in this way with a comparatively low speed of exhaust steam, which means light back pressure in the cylinders."

FAST RUNS ON THE PENNSYLVANIA.

In regard to exceptionally fast runs on portions of the Pennsylvania Railroad system, an article was published in the Philadelphia Record, of August 4th, 1882, which credited to Edward Osmond, locomotive engineer, the statement that he had run locomotive 724, an anthracite engine, between New York and Philadelphia in 93 minutes, stopping four times on signals, which, allowing 1½ minutes for each stop, would leave the actual running time 87 minutes.

An article published in the Philadelphia Times in June, 1886, says:—

"Lew Silence is one of the veteran passenger conductors on the New York division of the Pennsylvania Railroad. His name suits him, too. He seldom talks. He runs the 7.30 train to New York every morning. Yesterday he pulled a little note book out of his pocket, and, turning to June 13th, said: 'I made that memorandum 6 years ago. That was the fastest run ever made on the New York division of the Pennsylvania Railroad from Philadelphia to New York, 92 miles in 93 minutes. The train made three stops and seven slow-ups. There was only one car and an engine. The car was filled with passengers from the west, and I ran the train. There had been a storm up in the state the night before, and on the Middle division of the main line, between Harrisburg and Altoona, a big tree blew across the track. I think it was in the Lewiston Narrows. The fast line, as the train was called, was 4 hours and 21 minutes late when it got to Philadelphia. I got orders to take those passengers to New York as quick as an engine could pull a car. The whole road was cleared for my train. We went so fast that telegraph poles looked like toothpicks, and houses looked like soap boxes. One mile was made in 46 seconds, another mile in 47 seconds, and a third mile in 49 seconds. When we went down the hill at Menlo Park we traveled 3 miles at the rate of 78 miles an hour around curves and on the straight track. If a man had put his head out of a window he would have lost his breath. That's the history of the fastest run ever made on the New York division. I've been on some pretty fast trains, but that beat them all. I often see stories in the newspapers about fast runs made on western roads, but when you come to ride 92 miles in 93 minutes, through a thickly-settled country like that between this city and New York, why, it's fast riding, because an engineer has to slow up going through every big town. Still, we went through Elizabeth that day running 58 miles an hour.'"

The following specifications of a standard Pennsylvania Railroad class K passenger engine, with tender, were published a few years ago:—

Specifications for Standard P. R. R. Class "K," Passenger Engine, with Tender.

Gauge	4 ft. 9 in.
No. of pair driving wheels	2
Diameter of driving wheels	78 in.
Wheel centres	Cast iron.
Tires	Steel.
Total wheel base	22 ft. 7½ in.
Length of rigid wheel base	7 ft. 9 in.
Diameter of driving axle bearing	8 in.
Length of driving axle bearing	10½ in.
Kind of frames	Wrought iron, inside.
Distance between centres of frames	44 in.
Boiler material	Steel.
Thickness of boiler sheets, dome, and extended smoke-box	5/16 in.
Thickness of boiler sheets, barrel, outside fire-box, slope, waist, and roof sheets	⅜ in.
Thickness of sheet under dome	7/16 in.
Thickness of smoke-box	½ in.
Maximum internal diameter of boiler, wagon top	50¾ in.
Minimum internal diameter of boiler, wagon top	40¼ in.
Height to centre of boiler from top of rail	7 ft. 5¼ in.
Number of tubes	201
Inside diameter of tubes	1⅝ in.
Outside diameter of tubes	1⅞ in.
Tube material	Wrought iron.
Length of tubes between tube sheets	10 ft. 10 3/16 in.
External heating surface of tubes	1,085 sq. ft.
Fire area through tubes, less ferrules	2.9 sq. ft.
Length of fire box at bottom, inside	9 ft. 11⅝ in.
Weight on truck	29,300 lbs.
Weight of engine in working order	96,700 lbs.
Weight on first pair of drivers	32,900 lbs.
Weight on second pair of drivers	32,000 lbs.
Weight on truck	31,800 lbs.
Engine fitted with driver brake.	
Capacity of tank	2,400 gal.
Capacity of tank coal box	12,000 lbs.
Number of wheels under tender	8
Diameter of wheels under tender	33 in.
Material of wheels under engine truck	Cast iron, steel tired.
Diameter of tender truck journals	3½ in.
Length of tender truck journals	7 in.
Weight of tender, empty	26,100 lbs.
Weight of tender loaded	56,300 lbs.
Tender fitted with water scoop.	
Material of wheels under tender trucks	Cast iron, chilled thread.

THEODORE N. ELY, Superintendent Motive Power.

About 1884 another class of anthracite-burning engines, designated class P, intended for fast passenger trains on the New York divisions, were constructed. Their principal dimensions were as follows: Diameter drivers, 68 inches; cylinders, 18½×24 inch; tractive power, 120.6 pounds; total weight of the engine in working order, 100,000 pounds.

A description of one of the

HIGH SPEED WOOTTEN ENGINES,

used on the Philadelphia and Reading system, stated that its general dimensions were as follows:—

Cylinders	18½×22 in.
Diameter of driving wheels	68 in.
Diameter of truck wheels	30 in.
Wheel base	20 ft. 5⅜ in.
Diameter of boiler at smoke-box	53 in.
Diameter of boiler at fire-box	58¾ in.
Number of tubes	345
Length of tubes	9 ft. 2 in.
Diameter of tubes (outside)	1½ in.
Sectional area of tubes (inside)	514 sq. in.
Length of fire-box (inside)	8 ft. 6 in.
Width of fire-box (inside)	8 ft.
Combustion chamber	31 in. long.
Grate area	68 sq. ft.
Heating surface of tubes	1,232 sq. ft.
Heating surface of fire-box	151 sq. ft.
Heating surface of combustion chamber	32 sq. ft.
Total heating surface	1,415 sq ft.
Diameter of smoke-stack	18 in.
Exhaust nozzle variable, from 4 to 5 in. diameter.	
Weight on driving wheels	60,780 lbs.
Total weight of engine	89,750 lbs.

The Wootten engines intended for passenger and freight service, were designed by John E. Wootten, who was for many years general manager of the Philadelphia and Reading Railroad Company. They have attracted much attention, as they represent notable departures from general practice, particularly in the matter of a great increase in the available area of heating surface, and in the location of the cab, which is directly over the boiler, instead of at its rear. They have gained a high reputation for extraordinary steam-producing power and effectiveness, and also for ability to utilize the anthracite coal dust or other inferior classes of combustible materials as fuel.

THE STRONG LOCOMOTIVE.

Considerable interest has been manifested in a new style of passenger engine known as Strong's Express Locomotive, designed by George S. Strong, of Philadelphia, of which several specimens had been built at Lehigh Valley Railroad shops, under the superintendence of Alexander Mitchell previous to 1887. This locomotive embraces novel features, and it is claimed that it possesses unprecedented power to draw heavy passenger trains at high rates of speed over heavy grades. An elaborate report on its characteristics and performances, made in August, 1887, by E. D. Leavitt, jr., says: "In my judgment Mr. Strong's valve gear for the locomotive promises to do what Mr. Corliss has accomplished for stationary engines; it gives a good inlet and a free exhaust, its mechanical details are simple, and, with proper construction, will be durable and free from derangement." Of changes in boiler construction he says: "Mr. Strong has widely departed from previous locomotive practice at the fire-box end; he has discarded stays, and the deep fire-box, for corrugated circular furnaces and combustion chambers, whereby he gets a very large grate area and heating surface of the most effective type." The records of a number of performances are given, some of which are at the rate of about a mile a minute, but special significance is attached to the drawing of heavy trains at high rates of speed over steep grades, at points where two locomotives are usually necessary to perform similar service. One of these records is as follows:—

"On June 23d, 1887, engine No. 444 took a train out on the Northern Pacific Railroad to Brainerd, leaving St. Paul at 4 P. M. On this occasion the train consisted of 14 heavily-loaded cars, to wit: One United States railway post-office car; 1 express and 1 baggage car, all heavily loaded; 7 full passenger coaches, with people standing; 3 Pullman sleepers, and 1 dining car. The weight of this train was about 875,000 pounds. Immediately out of St. Paul station a 3-mile grade is struck, of 86 feet per mile. Our engine easily climbed the hill on schedule time, and when about two-thirds up the grade began blowing off steam. The Northern Pacific Railroad has a very heavy engine, specially constructed for this grade—weight, 106,000 pounds—but it has never succeeded in making this hill alone, with 9 cars. On this occasion the tractive pull of the engine could not have been less than 23,000 pounds, corresponding to a mean effective steam pressure of 150 pounds per square inch. The boiler pressure was 175 pounds. The tractive force due to grade alone, neglecting friction, is over 14,000 pounds."

On some roads 10-wheeled or mogul locomotives have been extensively used when it was necessary to pull heavy trains over steep grades.

IMPROVEMENTS IN DETAILS OF LOCOMOTIVE CONSTRUCTION.

MULTIPLICITY OF DETAILS.

A WIDE scope for changes or improvements is furnished by the multiplicity of devices and separate parts of a locomotive, as each of many things is subject to modifications and wear and tear. The Railroad Gazette published, in December, 1882, a detailed list of the pieces, and weight of the respective parts of a locomotive and tender, built in 1865 for the Illinois Central Railroad Company by the Hinckley Locomotive Works. It was of the American type, and a light engine, compared with many of the locomotives of the present day. The total weight of the engine was 54,078 pounds. The weight of each of the different materials used was as follows: Brass, 1,948 pounds; wrought iron, 29,627; cast iron, 19,785; wood, 2,718. The total number of pieces, including bolts, &c., was 4,904. The subdivisions of the engine were classified as follows: Boiler; domes, &c.; safety valves, &c.; throttle valves, &c.; steam and exhaust pipes; petticoat pipe, &c.; blower; smoke-box, door, &c.; smoke-stack; grates, ash pan, &c.; boiler braces; frames, &c.; bed casting, &c.; cylinders, &c.; cylinder cocks, &c.; steam chest, &c.; valves, &c.; pistons, &c.; cross-heads, guides, &c.; crank pins; driving wheels and axles; driving springs, &c.; driving boxes; valve gearing; reverse lever, &c.; pump; check valves; injector, &c.; check chains; sand box; bell and stand; hand rail; running board; cab, foot-board, &c.; wheel covers; cow-catcher, &c.; head-light, brackets, &c.; steam gauges, cocks, &c.; sundries. Of these sub-divisions, the following had an aggregate weight exceeding a ton: Boiler; frames; cylinders, &c.; crank pins; driving wheels and axles, and engine truck. The tender weighed 18,518 pounds. The aggregate weight of each of the materials used, in pounds, was as follows: Brass, 83; wrought iron, 8,330; cast iron, 6,987; wood, 3,118. The total number of pieces was 1,366. The leading sub-divisions were the tank; tender frame, &c.; tender trucks, and brakes.

COST OF ONE CLASS "C" BITUMINOUS LOCOMOTIVE ABOUT 1876.

Another indication of the complexity of the locomotive is furnished by detailed lists of the cost of various portions of a number of locomotives built in the Altoona shops about 1876, which are published in Dredge's account of the Pennsylvania Railroad. One of these lists gives the number of hours of labor devoted in each of the respective shops to each task involved in the completion of a class "C" bituminous locomotive and tender, as well as the cost of the materials used. The number of hours of labor and its cost in each shop was as follows:—

	Total hours.	Value of labor.
In smith shop	3,495.20	$557 63
In boiler shop	3,152.00	502 97
In lathe shop	2,695.10	430 12
In vice shop	1,158.00	184 74
In wheel shop	156.00	24 88
In erecting shop	3,061.00	488 46
In tin shop	338.00	53 97
In carpenter shop	490.00	78 48
In paint shop	412.00	67 66
Extra attachments	1,323.00	211 14
Total	16,280.30	$2,600 05

The total expenses for labor and materials, exclusive of shop expenses other than those for gas, fuel, and stores are as follows:—

Labor	$2,600 05
Proportion of gas-light	40 00
Proportion of fuel and stores	138 92
10,506 pounds forgings	332 93
17,096 pounds castings	389 58
6,360 pounds castings (driving-wheel centres)	143 10
8, 106 pounds iron	245 88
410 pounds boiler iron	24 60
276 pounds angle iron	9 04
626 pounds tank iron	37 56
650 pounds stay bolts	29 25
165 pounds planished iron	22 91
1,403 pounds crown-bar iron	70 15
130 pounds T iron	6 50
223 pounds B. B. iron	18 94
665 pounds sheet iron	26 60
15 pounds Russia iron	2 78
44 pounds boiler iron	4 07
8,093 pounds steel for boiler	778 32
296 pounds steel boiler-head plate	39 96
871 pounds cast steel	130 65
1,208 pounds cast spring steel	110 73
1,012 pounds old steel	23 90
1,129 pounds bronze	340 07
517 pounds brass	101 66
16 pounds Babbitt metal	3 23
1,349 pounds lead	94 43
53 pounds bar and sheet copper	16 68
Rivets	47 39
Bolts	31 19
Nuts	49 69
Washers	4 40
2 driving axles (1,780 pounds)	71 20
6 pairs wheels and steel axles	424 60
4 Butcher steel tires (3,993 pounds)	439 23
144 feet pipe	12 35
4 steel crank pins (414 pounds)	12 42
7 tube ends	5 76
1,721 feet tubes	395 83
131 pounds copper pipe	55 39
Copper rivets	1 20
Screws	6 83
Nails	2 24
12 steel set screws	3 00
17 pounds lagging screws	1 00
6 pounds black rubber	3 36
16 feet chain	1 25
11 pounds sheet rubber	4 04
Split keys	1 36
6 feet rubber hose	3 00
Brass and copper wire	0 25
Emery paper	0 06
81 pounds packing	1 66
Tacks	0 03
Wick	0 05
Sponge	0 03
4 pounds leather	1 28
Type metal	0 25
Glue	0 07
5 firebricks at 90	4 50
3 screw eyes	0 06
2 pounds soap	0 22
Brushes	0 45
1 tank cistern	425 00
1 signal bell	4 27
1 whistle	13 00
1 steel counter spring	8 10
1 water scoop hose	2 25
1 counter balance spring	7 61
2 unions	2 05
1 Richardson safety valve	10 12
2 swivels	1 28
4 hose nuts	4 20
4 deflector nuts	4 00
1 goose neck	1 89
1 steam chest gland nut	0 60
1 boiler check	16 35
2 tallow caps and joints	7 31
4 eccentric straps	27 00
8 driving-box shoes	14 00
4 driving-box wedges	5 20
4 spiral springs	7 87
10 oil caps	7 00
1 steel plunger	5 13
1 steam gauge	11 40
1 injector	87 00

6 Hand-rail tees	$5 40
4 acorns	3 12
4 tallow connections	2 80
1 hose	2 10
1 steam chest	1 50
1 blower	0 43
4 packing rings	22 20
10 face plates	2 88
1 spring balance	11 25
1 set of copper joints	5 04
2 hose strainers	0 34
4 truck oilers	0 48
4 brass oilers	1 08
Elbow, hinges, door slides	3 44
2 cab-door catches and knobs	1 32
1 tank cock	2 00
1 blower cock	6 30
1 pet cock	1 00
1 blow-off cock	5 50
2 stop cocks	3 83
4 cylinder cocks	6 00
2 heater cocks	4 50
4 gauge cocks	6 40
2 tallow cocks	6 50
1 scum cock	3 75
2 port cocks	2 40
1 steam-gauge cock	1 15
1 feed-pipe cock	2 80
112 feet deflector pipe	17 92
28 sheets of tin	6 14
370 feet water grate	59 20
9 bushings	1 31
3 pounds solder	0 75
9 lugs	0 59
250 feet oak	13 00
522 feet ash	20 50
509 feet pine	36 26
60 feet hickory	3 00
171 feet poplar	6 07
530 feet yellow pine	15 90
670 feet pine	16 75
36 feet cherry	1 44
24 feet weather strips	1 20
15 lights	4 35
Sand-paper	0 70
66 pounds bone black	2 64
20 pounds lead color	4 00
22 pounds filling	3 88
20 pounds "ironclad" paint	2 40
7 pounds Swedish green	1 75
4 pounds roofing brown	0 56
25 pounds dark Brunswick green	9 60
2 gallons black Japan varnish	2 40
2 gallons rubbing varnish	7 76
1 gallon finishing varnish	4 25
27 books of gold leaf	11 34
Total	$8,411 93
By brass and bronze turnings; turnings, borings, and cuttings.	68 12
Total	$8,343 81

INTERCHANGEABILITY OF THE PARTS OF LOCOMOTIVES.

In the progress of development one of the most important advances made was the adoption by a number of lines, and by locomotive manufacturing establishments, of a system providing for the interchangeability of the parts of all locomotives of a given class, many of the parts being also applicable to all or nearly all the engines in active use by some lines, or nearly all the engines made at a given establishment, without reference to the class to which the engines belonged. The significance of interchangeability in reducing the cost of repairs and construction can scarcely be overrated.

The old order of things, and the nature of changes effected in sundry quarters, are indicated by a paper read before the American Society of Civil Engineers by O. Chanute, formerly chief engineer of the Erie Railway, which embraced the following statements:—

"In 1874 there were upon the line of the Erie Railway (now the New York, Lake Erie and Western) 469 locomotives. These comprised no less than 83 different styles of engines, among which were scattered the following members of different styles of parts, which, being peculiarly exposed to breakage, required duplicates to be kept on hand: Seventy different styles of cylinders, 14 of crank axles, 17 of smoke-stacks, 41 of front end doors, 25 of driving-wheel centres, 71 of driving-wheel boxes, 50 of parallel rods, 42 of driving-wheel springs, 32 of eccentrics, and 25 of links.

In 1876, when the old 6-foot gauge was reduced to the standard of 4 feet 8½ inches, it was determined to make an attempt to reform the diversity, and the engines were first taken in hand. A consolidation engine was designed, and elaborate detailed drawings made to secure an absolute interchangeability of parts. Sixteen engines were built in accordance with the drawings and specifications, six of them at the road shops, and the remainder by two locomotive-building establishments. It was, however, subsequently found that the parts were not interchangeable, and it was then determined to furnish each contracting engine builder with a certain number of templets, in addition to drawings and specifications, for all engines put under contract, the original templets being kept in the company's own shops, and duplicates furnished as wanted. There were 39 of these templets for a consolidation engine. Those with holes in them are provided with hardened steel bushings. The result has been that 108 engines of this class were on the road in 1882 so exactly built that there was no difficulty in keeping duplicate parts on hand that were sure to fit in case of need. The same plan was adopted with respect to passenger engines.

The following table shows the cost of maintenance of locomotives on the road from 1870 to 1881, inclusive, the system having been inaugurated in 1876:—

Year.	No. of Engines.	Mileage.	Repairs. Cost.	Repairs. Cost per 100 miles.
1870	440	9,326,379	$1,312,798 33	$14 07
1871	475	10,579,766	945,207 63	8 93
1872	488	12,318,504	1,000,059 04	8 11
1873	497	13,697,460	1,096,755 36	8 00
1874	469	13,123,701	1,064,882 73	8 11
1875	461	12,762,879	807,719 85	6 33
1876	468	12,632,365	890,381 03	7 05
1877	466	12,587,998	621,543 89	4 94
1878	475	12,716,583	646,714 97	5 09
1879	504	14,174,523	539,638 97	3 80
1880	528	14,293,876	582,158 20	4 07
1881	544	15,905,282	630,181 43	3 96

This includes the building of new engines every year to replace those worn out and condemned.

Much of the saving shown was doubtless due to other reforms introduced by the management of the road, as well as to the substitution of steel for iron rails, to the decrease of wages subsequent to the panic of 1873, and to the fact that many of the engines were new; but a considerable part was certainly due to the adoption of rigid standards, and of interchangeable parts."

Corresponding changes, with like result, were made upon a number of roads. The practice became common among the manufacturers of locomotives of keeping in stock and furnishing to purchasers exact duplicates of such parts as were most likely to need renewals or repairs, and numerous efforts have been made by railway lines to establish uniform standards.

In Dredge's account of the Pennsylvania Railroad it is stated that the company had in 1876 "carried out completely their system of interchangeability of parts, and very many of the details of one engine are applicable to others of a different type. Thus the maximum variation is only four different patterns of brass or iron castings for any given part for the ten different classes of engines built." Tables relating to this subject are published, which show that "out of the 1,500 castings (in round numbers) required for 10 engines of the different types, 84 special patterns only are required among 9 classes, of which 43 are used in class I alone, while 178 patterns are distributed among the 10 classes. In the same way the variations in forgings are reduced to the narrowest limits. The number of forgings in each engine averages 245, and with very few exceptions these are identical in classes A, B, C, and D. A greater variety exists in the remainder, especially in class I, which is of quite a special type."

STEAM-GENERATING AND STEAM-CONTROLLING FUNCTIONS.

ONE of the greatest difficulties involved in the construction and successful operation of locomotives arises from the task imposed upon them of carrying the fuel, water, and heating apparatus necessary to furnish sufficient power for self-propulsion and for drawing heavy trains. It is largely on account of this requirement that stationary steam engines had long been in extensive use, and that a considerable number of steamboats were plying the waters of this and other countries before locomotives become an important factor in civilization. Convenience and economy in all that pertains to the generation of steam can much more readily be promoted in connection with the arrangements for stationary and marine engines than with those relating to locomotives; and progress in the direction indicated by this statement has formed one of the most desirable and difficult of the labors involved in useful improvements.

The bulk of the entire machine, including the tender, is made up of appliances for carrying fuel and water, and converting water into steam with a minimum of injurious or dangerous results and a maximum of useful effect. Many of the most important actual and projected improvements relate to steam-producing and steam-controlling functions. Problems which have awakened deep anxiety pertain to methods for generating a sufficient quantity of steam to meet the requirements of engines intended to draw heavy loads over steep grades or for fast passenger service; plans for saving fuel; devices for increasing the effectiveness of fire-boxes and diminishing smoke and spark throwing; and means for extracting from the steam generated an increased amount of useful service.

CHANGES IN METALS USED FOR VARIOUS PURPOSES.

Closely interwoven with this branch of locomotive improvements, as well as with others, is a notable change in the nature of the metals or materials used for given purposes, and especially the extensive substitution of steel for iron and copper, and iron for brass.

One of the important differences between American and English methods of locomotive construction hinges on the fact that in this country steel fire-boxes and iron tubes are in general use, while in England the common practice is to use copper fire-boxes and brass tubes. A tendency towards the use of steel plate for the shell of boilers in the construction of American locomotives began shortly before the end of the seventh decade, which subsequently was rapidly increased. On the latter subject a report of the boiler committee of the American Railway Master Mechanics' Association, read at the annual meeting, held in 1885, says: "Steel was reluctantly used in 1869, but 200 boilers of steel are reported for 1875, and it is recommended in that year, exclusively recommended in 1877, and the committee is unanimous in 1878." Rapid progress in the direction of manufacturing kinds and sizes of steel plate specially adapted for use as the material of boilers exerted an important influence in hastening this change. Other statements in the report referred to, relating to the substitution of steel, include the following: "Steel rivets are not reported as being used in 1871, neither are they used to any extent at this date, yet in view of all the conditions of the case, and until the obscure matter of galvanic action on corrosion, pitting, and furrowing is more clearly understood, it would be wiser to use steel rivets with steel plates, thus bringing metals together that are quite similar in nature and electrical affinities. . . . Steel flues were but slightly used in 1870 and their use at present is not common. They are thin, give a lengthened service, and in the hands of good workmen are (with borax and flux) readily pierced and rewelded to iron ends. Difficulty in rewelding was the chief defect mentioned to their discredit in 1873."

INCREASE OF BOILER PRESSURE.

Another important modern tendency is towards an increase of boiler pressure, which is facilitated by the increase in the strength of the materials used in the construction of boilers, and improved methods of manufacture. It is an advance step of great importance in promoting economy of fuel and adding to the efficiency of locomotives.

Interesting indications of the course of development in this respect are furnished in the following extracts from remarks made by J. N. Lauder, master mechanic of the Old Colony Railroad, at the annual convention of the American Railway Master Mechanics' Association, held in June, 1887: "The subject we are discussing now is the advisability of increasing the steam pressure. Now, I say it is advisable. We have gone on for years with 140 pounds, a good many of us have got to 150 pounds at the present time, few have got above that. Mr. Underhill, of the Albany road, has been carrying on his heavy engines 160 pounds with, it is claimed, good results, for a number of years. Mr. Stevens, of the Lake Shore, has recently put to work passenger engines carrying 180 pounds. I have got up to 175 pounds, and I think with good results. The fact is the transportation department is calling on us every day for greater duties. To-day more work is required from the locomotive, the cars are heavier built and they are loading the cars heavier, and we are expected to do more. Now, I think we have got our engines up to about the maximum weight and size. It is impracticable, it seems to me, in ordinary service, to go much above the weights we have in our heavy passenger and freight engines. The question then is, how to get more power without increasing weights? Some would say that the power of a passenger engine is depending upon adhesion; that is true to some extent, but there is very little trouble with well-designed engines of the present day slipping. To get more power without increasing the weight, I see no way but to carry higher pressure. It will not do to put on larger cylinders, because we are troubled now to get steam enough. The power of a passenger locomotive is just her capacity to make steam. She has got adhesion enough, she has got well-designed valve motion that distributes the steam properly; everything is all right, but the question is how to get steam. There are very few engines that will hold steam when running fast and cutting off at ten inches with full throttle. Now, if you can get the boiler to carry a higher pressure and work up to a short point, say eight inches, you have got an engine that is going to do the work better than with lower pressure. In my own practice an engine carrying 175 pounds of steam is hauling the Fall River boat train, composed to-day of fifteen cars, eleven of them 60 feet long and averaging 25 tons weight each. We have a heavy grade on the road to pull over, and we never had an engine that would make the steam to pull that train over in proper shape until we placed in service those we have recently put out. There is nothing peculiar about the engines; they have a large boiler, they are good, well-designed engines, that is all. They have got nearly 1,500 feet of heating surface, and that enables them to work freely and keep the steam up. We can work the train over that hill, cutting off at ten inches, 170 pounds steam pressure, and take it over in good style. When we strike a heavy grade we cannot use engines that will not come down, down, down until they get to 100 or 80 pounds. We must have them so that they will take the train up over the hills, and then, when they get away, work right up again. It is my belief that using high-pressure steam is a step in the right direction, and with the material we have to-day for building boilers and the knowledge we have for designing them, there ought to be no trouble in carrying 200 pounds of steam, and carrying it just as safely as 140 pounds. There is ample margin of safety, even at that high pressure, and when you get the high pressure and everything about the locomotive properly proportioned, you will find you have got a very economical working engine."

CONSTRUCTION OF FIRE-BOXES—GRATE AREA—ASH PANS.

A radical departure was made in the construction of the Wootten engines in the matter of increasing grate area, or the space available for making fires. By placing the cab over the boiler, and in front of the fire-box, instead of in the rear of the fire-box, it became possible to increase the width and length of the fire-box to an extent never previously attempted, with the power of spreading, relatively, their fires over a large surface. In a standard Wootten dirt-burning engine the grate area extends over a surface of 76 square feet, and the heating surface in the fire-box is 205 square feet.

These figures represent an immense increase in grate area, in comparison with other types of locomotives, and animated controversies have arisen in regard to the utility of this change. A report on improvements in locomotive boiler construction, made to the American Railway Master Mechanics' Association in 1884, after mentioning a number of particulars about which substantial uniformity of opinion had been established, enumerated other points involved about which there was still a great diversity and wide range of opinion, one of which was as follows: "The fire-grate area, and proper amount and division of air openings for rapid and thorough combustion of different qualities of coal. Mr. Wells says that the area of live grate should be as small as possible. Mr. Wilder says grate 120 inches long is economical for soft coal. Who can reconcile the difference of opinion?"

The adverse views of Mr. R. Wells, to which reference is made, were presumably those contained in a report he made to the annual convention held in 1882, which included the following remarks: "As a rule, it may be said that the area of 'live grate' should be as small as possible that will burn the amount of fuel necessary to generate the required amount of steam. The area of grate to give the best results will depend largely on the quality of coal used. For instance, a grate area of the proportions generally used in the Wootten boiler would certainly be wasteful in fuel when a good quality of bituminous coal was used, but would perhaps be the most economical where a very inferior quality of anthracite or semi-bituminous coal is burned. As nature has made the coals to differ greatly in kind and quality, equal variety in the proportions of grate, and to a certain extent of fire-box and boiler, seem necessary in order to obtain the best results in its consumption. Careful tests and observations must be relied on mainly to determine the proper modifications necessary to suit each variety of fuel. No one pattern will answer best for all kinds. It is important, more particularly, however, where bituminous coal is used, which is rich in gas, that the area of fire-box be large enough to give time for the perfect combustion of the gases before they enter the tubes, that the heating surface be as great and the boiler as large as possible within the limits allowable for the class of engine in which it is used."

These views can scarcely be considered decidedly antagonistic to large grate areas. While they advocate the doctrine that the "area of live grate should be as small as possible, that will burn the amount of fuel necessary to generate the required amount of steam," the real question is how large an area can be advantageously used for that purpose, and in view of the numerous chronic difficulties that have arisen from imperfect combustion of fuel, and lack of sufficient quantities of steam, there are good reasons for the belief that a considerable increase of the grate area of many classes of engines would prove beneficial, and the drift of progressive sentiment appears to be in this direction.

One of the advantages derived from a large grate area on the Wootten engine, to which sufficient importance has probably not been attached, hinges on the fact that it admits of a very gentle blast, and thus materially diminishes one of the most serious difficulties involved in the successful operation of many locomotives. If all goes well with the fire in the fire-box, and in devices for furnishing a sufficient supply of air to the fire from the rear, ends of great significance will be promoted. A neglect of ash pans and ash-pan arrangements, and of methods of firing, are closely interwoven with this subject. It is probable that lack of attention to details relating to ash pans is a prolific cause of waste of fuel and unsatisfactory results on a number of the locomotives of this country.

Much more attention is commonly given to this subject in England than in the United States, and this may be one of the important causes of differences in the amount of fuel consumed. In William Stroudley's description of the construction of locomotive engines for the London, Brighton and South Coast Railway, he makes the following remarks under the head of ash-pan: "Care has been taken to provide these engines with means for effecting perfect combustion of the fuel, and to prevent the emission of sparks. To do this they have been fitted with an air-tight ash-pan, which has an angle across the opening for the damper at the back. Water is allowed to escape into this to quench the ashes, and so keep the fire-bars cool and in good order. A deflector plate is placed across, above the opening for the damper, pointing inwards, and this throws the cinders which fall near the opening towards the centre of the ash-pan. The opening itself is covered to within 4½ inches of the top, with a perforated plate mounted on hinges; this allows the air to pass into the ash-pan, and prevents large cinders from falling out. A damper, having a handle convenient to the driver, is arranged to shut practically air-tight, giving him the means of adjusting the amount of air. These contrivances, combined with the comparatively extensive grate and heating surface, and with large blast nozzle, entirely prevent the emission of sparks. The ashes carried forward into the smoke-box would pass through a sieve having ⅛-inch mesh; the average quantity being for the heavy passenger or goods engines about 2¼ cubic feet per 100 miles run." This statement may, perhaps, indicate one of the few directions in which English methods may be advantageously imitated.

SIZE, ARRANGEMENT, AND NUMBER OF BOILER FLUES OR TUBES.

Great diversity of opinion continues to prevail in regard to the size, arrangement, and number of flues or tubes, but in comparison with engines of former eras there has been a great increase in the number generally used. The report of the committee on improvement in boiler construction of the American Railway Master Mechanics' Association, presented at the annual convention in 1884, stated that there was a material difference of opinion among the members of that body on the following points, viz.: "The proper diameter of flue for a given class of fuel. The proper clearance for space between flues, and their geometrical arrangement. The value of each additional foot in length of flues. If, as many suppose, any additional length beyond eight or nine feet is of no practical use, we had better shorten our boiler barrels, and obtain the same weight and cubical capacity by increasing their diameter. On our freight engines we can safely lift the centre of gravity very much higher than is being done at present, and even on our passenger engines the limit has not yet been reached. All increase of pressure will tend to lessen the value of the last few feet of long tubes. If by experiment the heating value of the tubes was ascertained, we could readily obtain the value of the fire-box surface by deducting from total heating value of boiler, and thus, having two values, we could better adjust the proportion between tube and fire-box surfaces."

A review of the mechanical differences of locomotive construction, as illustrated by locomotives at the exposition of railway appliances held in Chicago in 1883 stated that "the existing differences are principally in those parts of the locomotive relating to its steaming qualities. The great 'Mastodon,' for instance, has flues 2¼ inches outside diameter. The 'Little Mastodon,' a narrow-gauge engine standing near its larger contemporary, has flues 2 inches outside diameter, while the noted fast locomotive of the Philadelphia and Reading Railroad, also standing under the same roof, has flues 1½ inches in diameter. This last-mentioned engine has 345 flues with a total heating surface of 1,415 square feet, which number of flues equals 33 per cent. more than any other engine has upon the ground, and 10 per cent. more heating surface, yet there was a locomotive engineer present at the exposition with a model for a locomotive boiler containing a much less number of flues than any existing steam boiler contains to-day, with a largely increased diameter of flues. The fast passenger locomotive made by the Brooks Locomotive Works has flues 2 inches in diameter, and so has the small logging engine built by the Porter Locomotive Works, also the narrow-gauge passenger engine built by the Mount Savage Locomotive Works."

BOILER CONSTRUCTION—POINTS OF AGREEMENT AMONG AMERICAN RAILWAY MASTER MECHANICS.

The report of the committee on improvements in locomotive boilers, presented at the annual convention of the American Railway Master Mechanics' Association, enumerated the following points in boiler construction upon which that body had arrived at a general uniformity of opinion:—

1. The keeping of all longitudinal riveted joints above the water line.

2. The use of butt or welt longitudinal joints, instead of single or double lap joints; this practice chiefly doing away with furrowing at seams.

3. Use of mild steel for all parts of shell and inside fire-box.

4. Wide water spaces surrounding fire-grate—never less than 3 inches, and 4 inches preferred if possible, the width increasing upwards rather than narrowing, thus securing better circulation and freely getting rid of the steam as fast as it is formed.

5. Clearance space between flues not less than ¾ of an inch.

6. Disuse of inside ferrules to secure flues in tube sheet, a practice still common in other countries.

7. Exclusive use of lap-welded iron or steel flues, instead of composition.

8. Disuse of solid fire-door ring around fire-door opening.

9. As few holes as possible through shell, for connections, cocks, valves, &c., and as many as necessary for washing-out purposes.

10. Dome opening to be reinforced by strengthening plate or double flanging.

11. Rocking grates for bituminous coal.

12. Leaving boiler free for movement on engine frame; and the abandonment of back boiler-head braces, even with slotted holes to allow expansion.

13. Original or construction test by hydraulic pressure through injector, and, therefore, with warm water; but all subsequent tests by inspection with hand and eye, both internally and externally.

14. Not attempting to get rid of mud by providing with mud pockets or drums, but by blowing boiler off under full head of steam.

15. There is also to be noticed an increased initial pressure of from twenty to thirty pounds per square inch, and we see no reason why this practice should not become still more general, and the pressure steadily grow higher. Our steam is used so rapidly after formation, and is, therefore, so wet, that there is little cause for fear of trouble resulting from the higher temperature of the steam interfering with the smoothness of the working faces of valve and cylinder. This temperature is not increased one-tenth in raising steam from 140 to 200 pounds pressure, and if the full economical value of compounding locomotive cylinders is to be obtained, the pressure must be increased above 150 or 160 pounds, which is the maximum to-day.

EXTENSION SMOKE BOXES.

One of the devices applied to a large proportion of the locomotives traversing some sections of the country, and used to a very limited extent in other sections, about which a considerable diversity of opinion exists, is the extension front. Its operations have been reported to be very useful on a number of lines and alleged to be unsatisfactory or detrimental on others. On some roads it was discarded after being used for a considerable period and subsequently reapplied. Forcible speeches for and against it have been delivered at annual conventions of the Master Mechanics' Association. The views of its advocates, who appear to be in a decided majority in that body, and the nature of the purposes it serves are forcibly described in the following remarks made by J. N. Setchel, general superintendent of the Brooks Locomotive Works, at the convention held in June, 1887:—

"As a builder, if a man comes to me and tells me that the extension front end is of no use, I say all right; if he says 'it is a good thing and I want it,' I say, all right. But as a manager of the machinery department of railroads, as a runner of locomotives for many years, as a master mechanic and superintendent of motive power for many years, I am your equal, and when you tell me that an extension front end is a fraud, a humbug, and of no value, gentlemen, I will agree to take any engine you have on your road, take its record for the last year, give it to me in the same condition, as far as its wearing parts are concerned, for another year, and I will show you, with an extension front end, a cleaner train; I will show you less fuel used, and I will show you less fires along the right of way by a larger per cent. than the records of that engine show for the year previous. [Applause.]

And as an engineer I feel that I know what I am talking about. And when, gentlemen, you tell me it is of no value to increase the size of a nozzle half and three-fourths of an inch, it does seem to me that you are mistaken. You ought to think how hard you try to get your engineers to enlarge their nozzles by a little care in firing, and a little urging up to do this and to do that, to lower the petticoat pipe, or to raise it up, and to do this and that, and the other, and then to think that you can, by applying the extension front end in a proper manner, enlarge it by one-half or three-fourths of an inch at once. Is that of no value? Why, no man in his right mind ought to say that. Now, it is not very long ago that we had a committee on the extension front end, and they reported on it favorably, but perhaps they did not go into the details of it as minutely as they ought to, and show why it was abandoned on the roads that have taken it off, but to most of us it is very easy to see probable causes. We know when the extension front end was first applied it was done in a slipshod manner, and was not air-tight, and nothing of that kind will succeed unless it is as tight as a boiler, and that is where the point comes in.

Not many years ago I was appointed superintendent of motive power of a road, and one of the first things the general manager said to me was, 'Mr. Setchel, I want to know one thing. I want to know why the road right next to us runs the extension front end, and we cannot do it,' and I said, 'Why can't you do it?' And he said, 'They keep getting on fire with us. I can see the engines coming every night, and they look as if they had a thousand lights in front. They are all on fire.' The reason, of course, was because they were not air-tight. Why? If there had been no air going in there would have been no trouble. 'Another thing,' says he, 'passengers coming through catch on the iron railing, and they say it is the dirtiest line they were ever on. They say, 'Why can't you do as well as the Baltimore and Ohio road?' I said, 'I guess we can. Just as soon as I get warm in the seat I will try it.' And we did; and I think there are gentlemen here who can say it was a perfect success on that road. You can find thousands of passengers on that road that will bear testimony to the great improvement in dust and smoke.

On the Pan Handle line, with which I was connected for many years, the same thing occurred. The passengers coming to the Pan Handle over other lines where they were using the extension front end, when they got on the Pan Handle, were deluged with smoke. The general manager wanted to know what was the matter. Cars coming from the west, if they happened to be out in a rain storm, were just covered so you could not get hold of a spot on the railing without getting your hands covered with dust and soot, unless some kind brakeman had taken a piece of waste and wiped it off.

Now, these things are noticed by passengers. Not only is it forced on the public mind, but it is forced on the public body. I have in my mind a road where I was called on as an expert in a case involving many thousand dollars, and the whole thing hinged on this: 'Are you using the best known appliances for withholding sparks?' And they proved by a large majority of witnesses that the extension front end was the best. They were not using the extension front end, and the case went against them, and that would have paid for equipping and keeping front ends in order for the next ten years on that road. Now these are facts. When you say an extension front end is of no value, I want to say, first, how do you apply it? Then, how do you use it? How does your engineer use it? Does he throw in coal just as he did before, about ten or fifteen inches, and then complain that he does not get any draft?

Now, I think that it is the experience of every man that has had experience with the extension front end, that the engines steam better if you will carry a lighter fire. You can use a poorer quality of coal, because you use it thinner and give it more time for combustion than when you use a finer exhaust and take it out through the chimney by shovefuls."

It is conceded by some of the strongest advocates of the extension front, the use of which seems to be rapidly increas-

MODERN RAILWAY STATIONS.

ing, that most of the ends it served could be attained by an enlargement of the grate area, and it may be said to be a substitute for that expedient.

MISCELLANEOUS IMPROVEMENTS.

A number of other appliances intended to improve arrangements for controlling steam have been invented and extensively used during a comparatively recent period. The list includes valves, steam reverse gear, reverse lever latches, and a steam-gauge stand, which greatly diminishes dangers arising from the escape of steam. A report presented at the master mechanics' convention of 1882, stated that to Mr. Jacob Johann, the general master mechanic of the Wabash, St. Louis and Pacific Railroad, "first belongs the honor of making public a steam-gauge stand provided with a safety valve opening into the boiler which closes when an accident breaks off the stand." The value of effective devices for the accomplishment of such a purpose as a safeguard against one of the worst of railway dangers, can scarcely be overrated, and it is to be regretted that the entire subject of diminishing the perils arising from attachments to locomotive boilers has not received, in all quarters, as much attention as it deserves, in view of the good results that have attended the use of improved devices for insuring safety.

Valves and valve gear intended to promote the efficiency of locomotives have received much attention from inventors, manufacturers, and master mechanics. Considerable progress has been made in this direction.

BAD WATER, BAD FUEL, POOR FIRING, AND NEGLECT OF BOILERS.

Closely interwoven with nearly everything that relates to the production of steam used in locomotives are a series of complications that have their root either in impure water, inferior fuel, careless firing, or a failure to thoroughly cleanse boilers as frequently as that operation should be performed. The utility of a number of the mechanical improvements attempted or perfected would be greatly diminished if such complications did not exist, and a considerable amount of effort has been directed towards reducing their malign influence, such as endeavors to secure improved qualities of coal, to purify the water used or to advantageously change the chief sources of supply, to stimulate an increased degree of carefulness on the part of firemen by paying premiums for fuel-saving labors, and endeavors to establish improved methods of washing boilers. It is evident that there is a wide field for improvement in some or all of these respects in many quarters. There is a great difference in the steam-generating qualities and other characteristics of the numerous varieties of coal used as fuel for locomotives with which the country abounds, and similar differences in the quality of the water used on the locomotives which traverse various sections. In some cases it is practically impossible for managers to secure material improvements in these respects, but in other instances better supplies could be obtained with comparatively little trouble or expense if sufficient attention was given to this subject. Much of the waste of fuel which has occurred and is constantly occurring is caused by careless firing, and there is little doubt that the deplorable condition of many locomotive boilers in which impure water is used is due, in a large degree, to a failure to cleanse them with requisite frequency and thoroughness.

GENERAL LOCOMOTIVE IMPROVEMENTS.

STRENGTH, SIMPLICITY, AND ORNAMENTATION.

IMPORTANT general directions of development which have been frequently, but not universally adhered to, are towards an increase of the strength and simplicity, and a diminution of the ornamentation of locomotives. The increase of size necessitated an increase of strength which was often secured by an improvement of the materials used, such as the substitution of steel for iron, but the increase in thickness or weight of such parts as the shell of a boiler has not always kept pace with the enlargement of its dimensions.

Elaborate discussions have occurred in regard to the particular parts of a locomotive in which steel can be advantageously substituted for iron. The nature of the diversity of views prevailing in the early part of 1887 is indicated by an analysis of expressions of opinion or votes obtained from more than sixty officials by the Americau Machinist, the result being as follows:—

	In favor of— Steel. Per cent.	In favor of— Iron. Per cent.
Crank pins	56	44
Piston rods	62	38
Cross heads	50	50
Guides*	*44	*43
Driving axles	40	60

* 13 per cent. for cast iron.

Experience with the use of steel for the purposes mentioned above has, on a number of roads, either been very limited or unfortunate; while on other roads, on which all the matters involved had been thoroughly investigated, and the steel used was of the best kind obtainable in quality and shape, the results were deemed highly satisfactory. It seems to be one of the lessons of extended experience that any defect in shape, manufacture, or intrinsic quality of steel is apt to render it inferior to iron, while under the best attainable conditions superior results can be obtained from the use of steel.

The drift of development is decidedly towards an increased use of steel as the favorite material for parts of a locomotive which were formerly, and still are, to a great extent, made of iron.

The use of steel as the tire of driving-wheels of locomotives, and the adoption of the practice of fastening the tires on wheels by shrinkage alone, without any mechanical support whatever, are now substantially universal on American locomotives. These methods, and the use of chilled iron or paper wheels for the engine truck and tender, represent a great advance on English methods, and form important elements of the superiority of American locomotives. John Fernie, Member of the Institute of Civil Engineers, England, in a vigorous and instructive contrast of English and American locomotives, published a few years ago, said:—

"The American engineer set himself to improve the manufacture of railway wheels in the simplest of all ways by casting them; he improved the manufacture of his pig iron by carefully selecting pure ores and smelting them with charcoal. Then by admixture of various brands he made a metal which would take a deep chill. Then followed improvements in annealing them, and the cheapest, simplest, and most scientific way produced a wheel centre and a tire in one solid piece, unbreakable, and with great endurance, and with the advantage that when worn out on the tread it could, with a small addition of new metal, be again cast into a new wheel. Such are the wheels running under wagons, carriages, and the heads of locomotives to-day, and for many years they were running as the drivers in passenger and goods engines; of later years these driving-wheels have had steel tires shrunk on them. Such wheel centres require no compressive force to hold them together, and no bolts or complicated fastenings of any kind to bind the tire to the centre are used in America, and although the temperature varies from 40 degrees below zero to 110 degrees above it, the American wheel is perfectly safe in atmospheric changes which would ruin an English wheel."

It is easier to specify particular directions in which efforts have been made to stengthen the locomotive than to enumerate particulars of attempts at simplicity or avoidance of unnecessary complications. The latter object, however, has been kept steadily in view in many quarters, and in connection with the adjustment of numerous details.

A considerable amount of discussion has been devoted, in this and other countries, to the ornamentation of locomotives, and the dominant tendency has been towards a repression or abandonment of ornate styles. On the one hand it is alleged that sombreness leads to neglect, and on the other that superabundance of bright metallic work and elaborate paintings are ridiculous, expensive, and not in keeping with the labors performed.

RUNNING LOCOMOTIVES "FIRST IN, FIRST OUT," OR WITH TWO OR MORE CREWS.

Interwoven, to some extent, with the questions involved with the ornamentation of locomotives important considerations have arisen in connection with the adoption on the New York Central, and Pennsylvania, some years ago, of a system of operating locomotives by which the amount of service obtained from them in a given period was greatly increased. The old practice, and the custom still followed by many roads, is to treat the locomotive and a given crew as practically inseparable, the same men always running the same machine, and a given machine having only one crew to operate it, except in unusual emergencies; or in cases where this rule was departed from then two given crews would be identified with a given locomotive. The usual custom formerly was that no locomotive did more work in a given period than one crew could superintend, and the capacity of each engine was thus limited to the powers of endurance of one man. Where this state of things exists it is usually considered desirable that special pains should be taken to inspire in the minds of the engineers and firemen a feeling of pride in their particular engine, which is to some extent fostered or strengthened by a superabundance of ornamental work, as well as to stimulate and secure special knowledge of the peculiarities of each locomotive by its particular engineer. Of the new system, William P. Shinn, member of the American Society of Civil Engineers, in an instructive paper, written in 1882, on the Increased Efficiency of Railways for the Transportation of Freight, says:—

"Until quite recently every locomotive had its regular 'engineer,' and when he slept the locomotive was idle. This was changed on the New York Central and Hudson River Railroad some eight or ten years since, with but indifferent success, by the adoption of the rule 'first in, first out,' both for locomotives and crews, so that the next crew in order takes the next engine in order, and by having many more crews than locomotives nearly 50 per cent. more service is got from the latter, with less deterioration caused by frequent alternations of heating and cooling.

The Pennsylvania Railroad Company, after carefully experimenting with it on their Middle division, adopted it for their whole line in 1878, and the benefits of this system were shown by its results in 1879, as will be seen by reference to schedule E, giving the average miles run per annum by freight locomotives on the Pennsylvania Railroad, and the average number of tons of freight hauled by each from 1870 to 1881.

It shows as the average of all divisions:—

Per locomotive.	Miles run.	Average ton mileage.
In 1870	19,244	2,100,000
In 1878	20,000	3,000,000
In 1879	24,355	4,200,000
In 1881	27,614	5,100,000

an increase in mileage of 38 per cent., and in effective service of 150 per cent. from 1870 to 1881. Of course, much of this latter increase is due to the use of more powerful engines and better cars.

Of the general practice of this country, and the extraordinary results secured in some cases, in increase of locomotive mileage, Mr. Banderali, an experienced French engineer, after making extended personal investigations in the fall of 1885, made the following statements in a French journal, which were translated and republished in the Railroad Gazette:—

"The American companies which favor having a locomotive always run by the same engineman and fireman, Mr. Banderali says, do not hesitate to violate their own rule whenever traffic presses and they are not able or do not wish to get more engines. He gives the following as generally having two crews to one engine: The New York Central, the Cincinnati, New Orleans and Texas Pacific, the Boston and Albany, the Chicago, Burlington and Quincy; the Pennsylvania is having a very varied practice, in which the 'first in, first out" system is particularly noticed.

Exceptional cases of locomotive service are mentioned, as follows: On the New York Central, 415,790 miles, with passenger trains in five years, by No. 100, an average of 278 per day, costing 2.17 cents per mile for maintenance, and two similar cases. On the Pennsylvania Railroad No. 1,047 hauled passenger trains between Altoona and Pittsburgh, 14,100 miles, in July, 1885, and 14,200 miles in August, or an average of 457 miles per day for the two months. This was done with two crews. [This record has since been surpassed by performances of a passenger locomotive on the Philadelphia, Wilmington and Baltimore, running between Philadelphia and Washington, on which four crews were utilized.] The first left Pittsburgh at 7 A. M., and reached Altoona at 10.45 A. M.; left Altoona at 3.40 P. M. and reached Pittsburgh at 8.15 P. M.; when the second crew took it out at 9.10 P. M., reaching Altoona at 1 A. M., and started back at 2.30 A. M., reaching Pittsburgh at 6.15 A. M.

In the year 1884, the largest passenger mileage made by one locomotive between Philadelphia and Pittsburgh was 82,500 miles, by No. 95, and the largest freight mileage 48,800, by No. 975; the average passenger mileage of all engines being about 33,500, and the average freight mileage 25,200."

Mr. Banderali concludes as follows:—

"In the preceding statement of facts I have abstained from expressing any personal opinion on the comparative value of the different systems of using enginemen in locomotive service; evidently in a matter of this kind nothing is absolute. But one remarkable fact prevails; everywhere and whatever the system adopted, I found the engines in a perfect state of repair, and the motive-power service as satisfactory as possible.

In conversation with the vice-presidents, general managers, and engineers of the different companies which practice the system of more than one crew for one locomotive, I have found them all positive in the opinion that the system is advantageous, even from the point of view of the yearly expenditure for repairs. Mr. Thomson, of the Pennsylvania Railroad, and Mr. Buchanan, of the New York Central, told me that their own statistics proved that a great reduction of cost of repairs per mile run had followed the change from the old system to the new. I hardly dare say, fearing I may have misunderstood, that Mr. Buchanan calculated that the cost per mile had fallen from 6 to 3 cents; that is, had been reduced one-half.

It has not been without difficulty, however, that American engineers have succeeded in modifying the established customs. Their personal intervention, unceasing, energetic, patient, persistent, and at the same time adroit, has overcome all opposition.

As I have already said, they did not make the system general from the first, and without regard to circumstances. They applied it first where they thought it would have the best effect, profiting sometimes by a pressure of traffic, in which cases all engineers agree in adopting the system. Only gradually was it applied to the whole of a division or a system. They took care to interest the men in the success of their experiment. They associated together in the working of the same engine men of good character who were on good terms with each other, and in some cases it was often only after several months' experiment, quietly conducted, that they succeeded in realizing their plans and obtaining the satisfactory economical results which I have ascertained."

A report presented to the annual convention of the American Railway Master Mechanics' Association, held in June, 1887, on the control of engineers over driving-wheel tires, says:—

"From the answers received on the fourth question, 'Do you have regular engineers on your locomotives?' it appears that the practice of having regular engineers seems to be general. Your committee is of the opinion that it is much more economical to have regular engineers on engines, and that a saving of at least 10 to 20 per cent. is shown in the wear of tires, and it must necessarily follow that the same saving is shown in other parts of the machinery. Your committee is of the opinion that when it is necessary to use more than one crew on an engine, two crews should be assigned to each engine and held responsible for the same, allowing the crews to alternate. The best results are shown by having crews assigned in this way."

LOCOMOTIVE PERFORMANCES

are a vital feature of the life of operating railway companies, and expenditures for motive power form a large proportion of all operating expenses. Financial results are, therefore, greatly influenced by whatever materially affects cost, amount, and character of locomotive service.

The changes that have been progressing include not only a great increase in size and capacity, but a remarkable diminution in the cost of new locomotives, and in the expenses for repairing and operating them, per car mile or ton of freight moved. Elaborate statistics represent the reductions that have occurred in cost of locomotive service per train mile, but in many instances the actual results are much more favorable than those represented by these figures, on account of a notable increase in the amount of effective work represented by a train mile, through the increase in the number and weight of the cars moved. The cost of repairs per mile run and of fuel has frequently been greatly reduced, and the average amount of service performed by each locomotive materially increased. Reports of many companies have been phenomenally favorable in the matter of repairs, on account of a rapid expansion of operations which necessitated the frequent purchase of new locomotives, but aside from the effect of such additions great gains have resulted from the adoption of improved shop methods, the use of superior machine tools, and the establishment of standards which made similar parts of all locomotives of a given class interchangeable.

Of the durability and working capacity of American locomotives, Angus Sinclair, in an article printed in the National Car and Locomotive Builder, said:—

"Mechanical men who have given the subject attention do not require new statistics to convince them that the American locomotive is a wonderfully durable machine, considering the hard usage it is daily subjected to; but as others, who ought to be well informed, continue to remain ignorant about the working capabilities of the engine, we have collected a few facts that bear convincing testimony regarding the extraordinary durability of the locomotives turned out from American workshops. On April 23d, 1883, engine No. 137, a passenger locomotive designed by Mr. A. B. Underhill, superintendent of motive power, with cylinders 18×22 inches, and driving wheels 66 inches in diameter, was turned out of the Boston and Albany Railroad shops. After a few days of preliminary running on freight trains, this engine was put to running fast passenger trains. From Mr. Colby, master mechanic at Boston, we learn that the regular run of this engine has been 200 miles per day on heavy fast express trains until the last five months, when she has not run on Sundays. But during any busy season, or when locomotives were scarce, this engine did extra running, as was the case in May last, when she made 10,910 miles, or an average of 352 per day. The engine is still in good order, and will not be taken in for general repairs for some months. In doing this enormous amount of work, all the repairs effected on the engines, besides the minor running repairs, was turning the driving-wheel tires once and facing the valves once. The division where most of the running was done is very crooked, and has curves of 10 degrees. In 57 miles an ascent of 893 feet is made, and in the next 41 miles the descent is 833 feet. The train, including the engine and tender, generally weighed about 300 tons.

From Mr. Wootten, general manager of the Philadelphia and Reading Railroad, we learn that their engine No. 44, built in 1857, has run 707,119 miles, or over 25,000 annually; engine No. 49, built in 1857, has run 750,794 miles, which is over 26,000 annually; engine No. 57, built in 1859, has run 676,574 miles; No. 58, built in 1859, has run 844,196 miles, or upward of 32,000 miles per annum; No. 76, built in 1863, has run 657,917 miles, or close on 30,000 miles annually; No. 142, built in 1865, has run 630,260 miles, and No. 113 has since 1883 made a monthly mileage of 6,647 miles. Most of the Philadelphia and Reading Railroad engines are of Baldwin make, and all built within the last six years have the Wootten fire-box.

Mr. T. N. Ely, general superintendent of motive power of the Pennsylvania Railroad, has furnished us with many particulars bearing on the mileage made by passenger and freight engines on long and short runs on the main line and branches of the road, and covering about 60 per cent. of the whole number in service. Of the passenger locomotives, 65 made an average of 31,707 miles annually, and the engines have an average age of 13 years. The freight engines made an average of 22,331 miles, 349 locomotives being represented by the figures, the average age of these engines being 13½ years. As an example of specially long mileage, we may mention the case of engine No. 273, which, between September, 1875, and August, 1880, ran 251,552 miles, and was not off her wheels during that time. During the months of June, July, and August last, engine No. 1,047, on the Pittsburgh division, made 41,510 of a total mileage. In 1882, 72 passenger locomotives made an average of 45,936 miles each, the highest being 79,258 miles, the lowest 30,039 miles. In the same year 175 freight locomotives made an average of 36,584 miles each, the highest mileage having been 58,711 miles, and the lowest 30,000.

According to data received from Mr. H. Schlacks, superintendent of motive power of the Illinois Central Railroad, we find that some old Rogers locomotives belonging to that road have performed extraordinary mileage since they were first built; No. 23, which Mr. Morris Sellers ran for some months thirty years ago, and did exceptionally hard service pulling gravel to fill up the ground where many of the principal tracks at Chicago are now laid, was built in 1853, and has 1,029,965 miles of a running record, or over 32,000 miles per annum of exceptionally protracted service. No. 25, built in 1854, has run 1,007,973 miles; No. 35, built in 1854, has run 1,015,488 miles. Of their recently-built engines, No. 221, put to work in 1880, ran 168,161 miles up to the end of August; No. 226, put to work in 1883, has run 82,437 miles to date, at an expense of 1.94 cents per mile for repairs. The oldest engines mentioned belonging to this company are still in service, and are in fair order. They might still be considered good for 10 years' more work, only that they are getting too light for the heavy trains now handled all over the road.

Mr. William Buchanan, superintendent of motive power of the New York Central road, has supplied us with figures showing the mileage of a few of his passenger engines. These engines have cylinders 17×24 inches, driving-wheels 69 inches in diameter, steel fire-boxes of the Buchanan pattern, and the working weight of engine is about 35 tons. From July 1st, 1884, to June, 1885, engine No. 105 ran 95,003 miles at an expense for repairs of 95 mills per mile; from October 1st, 1883, to December 1st, 1884, engine No. 82 ran 103,455 miles at an expense for repairs of 97 mills per mile; from July 1st, 1883, to December 1st, 1884, engine No. 84 ran 121,750 miles; from April 1st, 1884, to June 1st, 1885, engine No. 453 ran 105,135 miles; from October 1st, 1883, to April 1st, 1885, engine No. 289 ran 140,546 miles; from November 1st, 1883, to October 1st, 1884, engine No. 338 ran 98,405 miles; from May 1st, 1884, to July 1st, 1885, engine No. 613 ran 118,256 miles. These figures are taken from thoroughly reliable records."

IMPROVEMENTS OF CARS.

ONE of the most important of all the transportation improvements in this country consisted in a long series of extraordinary advances in cars, which included a rapid increase of their number, numerous additions to varieties, a notable increase in size and capacity, and the adoption of many useful devices for promoting the comfort of passengers and the economical movement of freight.

Intelligent foreign critics of railway appliances have repeatedly praised in high terms the systems of car construction adopted here, even when they found much to condemn in the permanent way of many lines, and in comparison with other nations the record of the United States, in connection with this subject, is remarkably good.

INCREASE IN NUMBER OF CARS.

The rapidity with which the number of cars increases more than keeps pace with the increase in railway mileage, as many of the older lines usually make considerable additions every year, and the gain is even greater than that indicated by statistics, as a large proportion of the new freight cars have considerably more capacity than those formerly used.

The following statement, compiled from Poor's Manual, approximately represents the movement of recent years:—

	Passenger cars.	Baggage, mail, express, &c.	Freight cars.
1877	12,053	3,854	392,175
1879	12,009	4,519	480,190
1880	12,789	4,786	539,355
1881	14,548	4,976	648,295
1882	15,551	5,366	730,451
1883	16,899	5,948	778,663
1884	17,303	6,411	798,399
1885	17,290	6,544	805,519
1886	19,252	6,325	845,914

The Railroad Gazette compiled and published the following partial summary of locomotive and car construction for eight years, ending with 1887:—

	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	Total.
Locomotives built by 19 private firms	2,044	1,436	800	1,149	2,067	2,282	1,977	1,405	13,160
Freight cars built by 15 car works	12,131	7,870	2,073	3,043	9,756	15,636	15,961	10,588	77,658
Freight cars built by 29 railroads	4,014	2,225	1,482	2,634	4,031	2,943	4,085	3,250	24,664
Total	16,145	10,095	3,555	6,277	13,787	18,579	20,046	13,838	102,322
Coal cars built by 15 car works	11,644	5,067	1,729	4,425	3,927	5,035	6,535	3,510	41,872
Coal cars built by 29 railroads	2,412	1,079	869	1,213	1,890	1,238	1,565	196	10,462
Total	14,056	6,146	2,598	5,638	5,817	6,273	8,100	3,706	52,334
Passenger, baggage, mail, express, and caboose:—									
15 car works	496	344	209	257	406	294	286	292	2,584
29 railroads	167	112	50	117	181	164	121	103	1,015
Total	663	456	259	374	587	458	407	395	3,599
Sleeping, dining, buffet cars, &c.:—									
15 car works	65	53	53	64	49	50	65	16	415
29 railroads	2	4	7	8	11	10	10	1	53
Total	67	57	60	72	60	60	75	17	468

The census report of 1880 on railways states that there were then in the United States 12,330 passenger cars, 4,475 mail, express, and baggage cars, 375,312 freight cars, and 80,138 cars of all other descriptions, owned by railroad companies, and that, beside this equipment, there were used upon certain roads "sleeping cars, palace or parlor cars, express cars, and other rolling stock, owned by corporations or companies separate and distinct from the railroad corporations, such as freight and transportation companies, the Pullman Car Company, railway equipment companies, United States Rolling Stock Company, &c."

As the number and capacity of cars available approximately indicate the amount of business transacted on the railways of each section, their distribution between the lines of different groups is a matter of some interest. At the close of 1885 it was as follows: The New England group, with a mileage of 6,309.78 had 45,935 cars of all classes. The middle group, composed of New York, New Jersey, Pennsylvania, Delaware, and Maryland, with a mileage of 18,578.28, had 329,328 cars. The central northern group, embracing Ohio, Michigan, Indiana, Illinois, and Wisconsin, with a mileage of 41,518 66, had 268,589 cars. The south Atlantic group, containing Virginia, West Virginia, North Carolina, South Carolina, and Florida, with a mileage of 12,165.89, had 29,114 cars. The gulf and Mississippi valley group, with a mileage of 9,675.19, consisting of the states of Alabama, Mississippi, Tennessee, Kentucky, and Louisiana, had 33,197 cars. The south-western group, consisting of Missouri, Arkansas, Texas, Kansas, Colorado, and New Mexico, with a mileage of 22,223.07, had 61,794 cars. The north-western group, containing Iowa, Minnesota, Nebraska, Dakota, Wyoming, and Montana, with a mileage of 19,362.82, had 39,792 cars. The Pacific group, containing Washington Territory, Oregon, California, Nevada, Arizona, and Utah, with a mileage of 7,952.01, had 18,261 cars.

While there was in the entire country an average of between 600 and 700 cars to each hundred miles of main line, the equipment of the roads of different groups varied from a little more than 200 cars per hundred miles of main line to nearly 1,800 cars per hundred miles, and the differences between companies was much greater. The proportionate amount of equipment in the United States falls considerably below the standard of Belgium, France, Germany, and Great Britian, but approximately equals or exceeds that of most other countries, and the train movement on some of the busiest American lines exceeds in magnitude that of nearly all foreign railways.

MAINTENANCE AND CONSTRUCTION OF CARS.

As the tendency is nearly universal in this country, except during eras of disastrous developments, towards a rapid increase of traffic, the maintenance of old cars and construction of new ones form an industry of considerable importance, in which many railway lines and private firms or companies are engaged. All operating railway companies are obliged to maintain departments of varying magnitude, which are specially devoted to repairing cars, and they frequently, also, construct new cars. There are also a large number of car-building establishments. A list of car builders in the United States and Canada in July, 1887, gave the names and locations of ninety car works.

In the manufacture and repair of cars a number of extensive auxiliary industries are conducted in independent establishments. Many car wheels, car axles, and car springs are thus made, and the requirements for fitting up in the most approved style modern passenger cars are so exacting that they include an immense variety of things specially adapted to them, and also many others that are used in dwellings, hotels, or carriages.

INCREASE OF VARIETIES OF CARS.

THE general subdivisions of passenger, baggage, mail, express, and freight cars have been supplemented by a number of minor divisions which represent important distinctions.

PASSENGER CARS.

Cars devoted exclusively or chiefly to the transportation of passengers have assumed types which either originated in this country or embody an immense number of American improvements. The list includes the following varieties:—

The first-class passenger car or coach, often called a day-coach, which is the car used by the bulk of passengers. The second-class passenger car or coach, which usually closely resembles the car designated as first class, although it may be somewhat antiquated or relatively inferior in its interior arrangements, and it is frequently used as, and designated, a smoking car. The parlor car, bay-window parlor car, drawing-room car, chair car, or palace car, contain more comfortable seats or more luxurious and attractive surroundings to a sufficient extent to command an addition to the standard fare. The sleeping car, in which berths or beds are made up for the use of passengers at night, and the car rearranged so as to furnish convenient seating facilities during the day. Such cars, as well as a number of other high types of cars, including parlor cars and dining cars, are supplied by the Pullman, Wagner, and Woodruff car companies to railway companies, under various business arrangements, and they are used in a large proportion of the first-class through travel of the country. The buffet car and hotel car combine facilities for sleeping with arrangements for furnishing food; the meals provided in the buffet car are usually comparatively light lunches or repasts which do not require much cooking. The use of the hotel car, in which more diversified meals are supplied, is confined to a comparatively few routes and is apparently declining. One of the varieties of the buffet car is used as a smoking car, and not as a sleeping car, while from the side-board, which furnishes the origin of its distinctive name, various articles of food or refreshments are supplied. There are suburban excursion cars and observation cars, used in ordinary passenger travel, especially during the summer season, and on routes leading to or from places noted for scenic attractions or mountain or sea breezes, the special feature of these cars being free vent to air currents or exposure similar to that obtained in a carriage which has a top but no side curtains. Aside from these there are a comparatively small number of cars fitted up for excursion parties or important members of theatrical troupes, which combine specially luxurious arrangements for sleeping, dining, and resting. They probably furnish the most notable contrast, among the cars available to the public, to emigrant cars, some of which are fitted up as sleepers in an inexpensive manner, but all of which are usually decidedly inferior in interior finishings and furnishings to the passenger coaches in contemporaneous use on the lines over which they are running.

In the construction of the various grades of passenger cars a vast amount of mechanical and decorative talent has been displayed. Every detail has received prolonged and thoughtful consideration, and changes representing advances or improvements of one kind or another have been gradually introduced and are constantly under consideration. So far as the vehicle is concerned, the higher classes of American cars approximately typify the perfection of travel, and yet active brains are always at work in devising additional improvements, and there are few periods in which changes of considerable consequence are not extensively introduced. Passenger cars have gradually been advanced through many stages of development, representing forward movements in each particular, to an extent that approximately parallels changes in domestic architecture and household arrangements. Everything relating to comfort, ease, health, elegance, and ministration to luxurious tastes, including ventilation, heating, lighting, strength, safety, mechanical efficiency, avoidance of jarring or jolting, ornamentation, superiority of appliances for supplying food or securing rest or sleep, has received due consideration, on a stupendous scale, regardless of expense.

The highest type of modern American cars are traveling mechanical triumphs, which embody all useful known inanimate devices for ministering to the comfort and luxurious tastes of mankind, at all hours of the day or night, whether the passenger is asleep or awake, whether he wishes food as he is journeying at a rapid pace, or prefers a day coach, a parlor car, a smoking car, or a sleeping car. None but those who zealously endeavor to familiarize themselves with details can form even a faint conception of the immense variety of things pressed into useful service in passenger cars.

One of the great fields of progress has been the increase of the strength of the car. The best of the modern passenger cars are strong enough to resist shocks and concussions which would inflict fatal injuries upon the inmates of an inferior and relatively weak car. Other important spheres of effort related to methods of lighting and heating cars, to seats, platforms, couplings, lavatories, retiring rooms, ventilation, baskets, and miscellaneous furnishing and finishing, and to plans for improving all the details of passenger-car trucks. They include articles designated by more than a hundred names, embracing wheels, axles, journal boxes, transoms, springs, equalizing bars, brake beams, brake shoes, and many other things. In their arrangement and improvement American mechanics and car builders have perfected a long list of devices which are superior to others used for similar purposes in any foreign country.

The latest of the notable achievements, which is the construction of the vestibule train, combines the power to ward off danger in the highest state of development with the most important of all other advances made in connection with the trucks, decoration, construction, or furnishing of dining, sleeping, and parlor cars. Its distinguishing feature is the coupling together of the best of these cars under conditions that render it as safe and comfortable for the passenger to move from one car to another as to pass between the rooms of a fixed habitation, and at the same time to provide new safeguards against the danger of telescoping cars, which are presumably infallible.

BAGGAGE, MAIL, AND EXPRESS CARS

are frequently run as parts of passenger trains. Some of the cars used to carry baggage in a portion of their available space are used partly for that purpose and partly for the carriage of passengers. When specially arranged for such a dual use they are styled combination coaches or cars. An analogous purpose is served by mail or postal cars, which, in addition to carrying heavy mails, transport postal clerks or officials engaged in assorting mail matter. Express cars are fitted up for carrying light packages, valuable articles, and valuable perishable freight, on passenger trains. There are combination baggage cars, which have apartments set off for mails or express matter, or both, in addition to space for baggage.

Postal cars possess special interest and significance on account of the opportunities they afford for expediting mail matter. They were first introduced in this country in 1864, about which time they commenced running on one important north-western route, and between Washington and New York. The service performed by railways in hastening the dissemination of letters and newspapers forms a very important portion of their labors in an intellectual point of view. Mechanically some of the postal cars embody interesting features. On some routes they are of unusual length and weight, to furnish the requisite capacity, and one of the appliances used is a mail catcher, consisting of a bent iron bar, for taking up or catching mail bags while the train is in motion.

CARS USED IN OPERATION AND CONSTRUCTION, OR WORKING CARS.

A considerable number of cars are used to carry persons officially connected with railways. They include the officers' car, used chiefly by high railway officials in passing over their lines, or by distinguished passengers, such as Presidents of the United States, to whom courtesies are extended. These cars are usually provided with kitchens, a sleeping apartment, and a drawing or sitting room. They are sometimes fitted up in an elegant and attractive style. A pay car is a special variety. For the accommodation of the conductor and train men of freight trains, for carrying various stores and tools, and, in some instances, for displaying signals, a caboose car or cabin car is attached to the rear of freight trains. On some roads eight-wheeled cars are used for this purpose, and on others four wheeled cars, the latter being usually termed cabin cars.

In the modern style of rapid construction, especially in comparatively new western, south-western, and north-western regions, trains specially fitted up for the purpose of hastening operations, and cars intended to facilitate particular labors play an important part. A novelty rarely attempted, which involves obvious perils, was a construction train used in the rapid extension of the St. Paul, Minneapolis and Manitoba Railroad in 1887, of which a brief description says: "This train left Minot, Dakota, on April 2d, 640 miles east of Helena, and 531 miles west of St. Paul, reaching Helena, Montana, November 19th. It carried about 250 men, who ate and slept in the three-story cars. Some pitched tents on the top of the lower cars, preferring plenty of fresh air. The train also carried the feed for 200 teams used in hauling ties and bridge timbers. The cars have strong cables attached to the sides, which are fastened to the ties in heavy winds, as the cars are somewhat top heavy." There are cars provided with appliances for driving piles, and others for digging ditches alongside of a track, a combined steam shovel and derrick car, gravel cars, ballast cars, and a car styled a scraper and leveler. There are hand wrecking or derrick cars, carrying ten-ton cranes, steam wrecking or derrick cars, and a block car, attached to wrecking trains, for carrying blocks, ropes, chains, and tools. Also snow plows, tool cars, sweeping cars, ferry push cars, which are long platform cars, used for pushing or pulling other cars off a ferry boat, when it is approached by an incline too steep for locomotives, and a number of varieties of hand cars.

One of the most interesting of the cars used for assisting railway labors is a dynagraph or inspection car, which records the speed of trains, amount of fuel used, and imperfections in track. Of one of these, invented and extensively used by P. H. Dudley, a description says that the dynagraph "is a very complicated machine, occupying a space three or four feet square in a car constructed especially for the purpose, and contains, besides the dynagraph, excellent accommodations for the inventor and his wife, who accompanies him, and is an excellent assistant. The draw-bar of the car is connected with a piston, which works in a cylinder under the floor, and which is filled with oil. These are so arranged that if the draw-bar is subjected to strains of either tension or compression they are resisted by the oil in the cylinder. From this cylinder there runs a small pipe, which connects with a small cylinder placed upon the top of the machine. This has a piston in it, which connects by a rod, and carries a pen which draws a diagram of the resistance of the train upon a roll of paper some thirty inches in width. This paper is fed over a table at the top of the machine by a very ingenious contrivance. As the paper rolls across the table a stationary pen marks what is called a base line. This line is followed by the pen mentioned above when there is no tension upon the draw-bar, but as soon as there is any pressure in the draw-bar cylinder the pen is carried away from the base line a distance proportional to the pressure, and the diagram immediately indicates the tension on the draw-bar. The speed of the train is recorded by means of an electrical attachment, with a chronometer clock upon the machine, which indicates the space traveled over each second. The next pencil is arranged to mark the distance traveled over every ten seconds, and still another pen is used to record minutes. A pen is also arranged so that by an electrical connection it records each revolution of the driving wheels. Another records the mile posts as they are passed, which is done by an assistant, who touches an electrical key at each post. The alignment of the road—that is, the curves and straight lines—are recorded in a similar way. A pen next to this is connected with a water meter attached to the feed pipe of the locomotive, and records the quantity of water consumed at different times and places. Still another pen is arranged so that an assistant in the locomotive records every shovelful of coal as it is put on the fire. The same pen has been used to record the time that black smoke escaped from the chimney. A pen is also provided which records the distance run by the car, and another records the indications of an anemometer placed on top of the car. The fourteenth pen gives a record of the surface of the road, and shows at a glance any inequalities that exist. Besides the above, there is also attached to the machine a finely-constructed integrating apparatus. The pens used to record the numerous phenomena connected with train resistance, &c., consist of small glass tubes, which are drawn to a fine point and filled with eozine, one of the products of coal-tar distillation. A half grain of this is dissolved in an ounce of water, and makes a beautiful red color."

FREIGHT CARS.

IN numbers, industrial importance, and revenue-earning power freight cars greatly exceed all others. They are the principal source of net income to a large proportion of American roads. Much has been done to construct cars specially adapted to particular classes of traffic, and also to invent plans for promoting the economic movement of every description of freight. The varieties include the following: Box car, box stock car, cannon car, coal car, coal dump car, coke car, double-deck car, drop-bottom car, dump car, flat cars, fruit car, furniture car, gondola car, grain car, heater car, hopper-bottom car, ice car, iron-hopper coal car, lumber car, logging car, milk car, mine car, oil or tank car, ore car, refrigerator car, stock car, tip car.

One of the distinctions is between four-wheeled cars and eight-wheeled cars. Few of the former are now used, except for carrying coal, and even for this purpose, as well as others, there is a strong modern tendency to use eight-wheel cars to increase capacity, which is one of the most important methods of reducing the cost of extensive movements. Freight cars are rarely furnished with more than eight wheels, but when they are to be used in transporting large cannon or heavy machinery they are sometimes supplied with sixteen wheels and given a carrying capacity of more than a hundred tons.

Of the classes of cars used for special purposes, some of which have received particular attention, are

HEATER CARS, REFRIGERATOR CARS, FRUIT CARS, AND STOCK CARS.

The heater cars are used chiefly in high northern latitudes, and mainly in New England, for the purpose of transporting fruits and vegetables under conditions that will prevent them from freezing during cold seasons. These cars are generally heated by particular forms of mineral-oil lamps, ingeniously arranged with the view of automatically controlling the temperature by the expansion and contraction of metallic rods.

A wide range of usefulness has been secured for refrigerator cars in connection with the transportation of dressed meat over long distances, a business that rapidly gained great magnitude, and various other perishable articles of food. A number of varieties of these cars have been constructed, and during late years important improvements have been made. One class uses ice and salt for refrigerating; another uses ice only; in some cars ice is carried in their upper portion, or overhead in ice pans; in others ice is carried in the ends of cars in ice racks or tubes, and great differences exist in the extent to which the desirable atmospheric conditions are produced. The temperature aimed at is a few degrees above the freezing point. On account of the magnitude of the interests involved great losses would result from a failure to produce the necessary effects, and as such failures are certain to be detected by discriminating food consumers, the success which has attended modern efforts to increase the demand for articles carried in refrigerator cars affords convincing proof of the excellence of the highest types of these useful vehicles. They have done much to make the perishable food products of each section of the United States available to all other sections of the country, or at least to prevent distance being a barrier to such an interchange.

An analogous purpose is served by fruit cars in which neither ice to cool nor lamps to warm are used, but in which ventilation is necessary, and is provided by ventilators that can be opened or closed while the car is in motion. The success of efforts in this direction, and the practice of attaching fruit cars to passenger trains to increase speed, have done much to develop the fruit trade of California, and the carriage of various kinds of fruit and vegetables from other sections over long distances in cars which do not contain novel appliances has had an important influence in developing producing regions, and diversifying the food supplies of large cities and numerous districts.

Stock cars for the transportation of cattle, sheep, and hogs over long routes are used extensively, and they, too, form important agencies in the distribution of food supplies. Some cars are intended for the movement of horses, including very valuable animals. A car known as a box stock car, which is substantially an ordinary box car with either large grated or slatted openings for ventilation, is little used except for transporting horses. For the movement of specially valuable horses, such as famous trotters or racers, elaborate accommodations are sometimes provided, including the padding of the interior of the cars, so as to reduce the risk of injuries to the lowest possible limits, and ingenious devices for ensuring ample supplies of food and water and attendance. For the transportation of sheep and hogs a double-deck stock car, with two floors, one above the other, is used. Considerable attention has been given to their construction, and some have been built of sufficient strength to carry heavy loads. Many of the modern stock cars are so designed that they can be used as double-deck cars. The transportation of live cattle over long distances is a business of great magnitude, many cattle being moved in cars from one set of pasture grounds to districts in which they are fattened, and many other cattle being sent by rail to abattoirs or slaughter houses after they are supposed to be in proper condition. The ordinary cattle cars are all provided with ample facilities for ventilation, having many open slats. But on account of sufferings of the animals, in some instances, from lack of food or water, overcrowding, detentions, or other causes, special efforts have been made to promote the construction of cars popularly styled palace stock cars, which are intended to carry stock with less injury and more comfort than the vehicles generally used for this purpose. Endeavors have been made to secure the passage of laws intended to enforce the adoption of improved methods, and the American Humane Association has given prizes for designs of palace stock cars which it considered most meritorious, to A. C. Mather, of Chicago; W. Stuart Hunter, Belleville, Canada; J. M. Lincoln, Providence, Rhode Island; Montgomery Palace Car Company, New York city; Burton Stock Car Company, of Boston, Massachusetts; Thomas Clarke, of Truro, Nova Scotia; and John W. Street, of Chicago, Illinois.

MILK CARS AND GRAIN CARS.

In addition to the cars referred to above, box cars are used frequently for the transportation of food or products which can be converted into food. Two of the most important classes containing special mechanical arrangements are milk cars and grain cars. The former play an important part in the business of divisions of railways located near large cities, while the latter are used extensively in such lengthy movements as those made between the Mississippi valley and the Atlantic seaboard. Milk cars, used for carrying milk in cars, generally resemble baggage cars, and are commonly provided with springs similar to those placed under passenger cars. Box cars are rendered appropriate vehicles for carrying grain by having a tight inside grain door attached, to prevent the grain from falling out. Many of the modern box cars have an attachment to accomplish this purpose which can be thrown on one side when other articles are to be carried, and other kinds of doors are most convenient, and a number of devices have been invented to facilitate such operations.

COAL CARS, COKE CARS, AND TANK OR OIL CARS.

The largest amount of tonnage moved on railways of any one class of articles consists of coal and coke, especially the former. For a considerable period anthracite furnished the bulk of such tonnage, and it still supplies a large proportion, but bituminous coal, semi-bituminous coal, and coke are forwarded by rail in large quantities. The cars used are generally, but not universally, of a kind exclusively devoted to this traffic, hauling no back loads, and many of the movements are at very low rates. Earnest endeavors have, therefore, been made in various ways to promote economy by improvements in car construction, and a variety of styles of coal and coke cars have been manufactured. They commonly have drop or hopper bottoms to facilitate unloading, and include the following styles: A 4-wheeled wooden anthracite coal car, valued at from $205 to $250, weighing from 7,600 to 7,900 pounds, with a carrying capacity of 13,000 pounds; iron cars, with 4, 6, or 8 wheels, with drop or hopper bottoms; ordinary flat or platform cars, with side-boards; hopper-bottom gondola cars. The modern tendency is to increase capacity, and use various sizes of drop-bottom gondola cars, some of which weigh 16,000 pounds, and have a capacity of 28,000 pounds. Others weigh 22,000 pounds, and have a capacity of 40,000 pounds. During late years the capacity was increased in some instances to 50,000 pounds, and subsequently to 60,000 pounds. Coke cars differ mainly from the longer styles of gondola cars in having higher sides, the upper portion being slatted.

Tank cars, or oil cars, used for the transportation of petroleum, furnished for a considerable period the only available facilities for moving crude oil from the producing regions to distant refineries, but subsequently pipe lines leading to the seaboard and other centres of refining industries were constructed. This change materially diminished the utility of tank cars, but a considerable movement is still made in them, which now consists largely of refined instead of crude oil to southern districts, from which cotton-seed oil is forwarded in them as a back load. They are cylindrical, boiler-iron vessels, resembling somewhat in shape the boiler of a locomotive. They are held in place on a platform by tank bands, and prevented from turning. They have a tank dome and a tank nozzle, used for emptying the oil. Their usual capacity is from 3,700 to 3,850 gallons.

LUMBER CARS, LOGGING CARS, FLAT CARS, GONDOLA CARS, AND TIP CARS.

Peculiarities in car construction, intended to promote convenience and economy in loading, unloading, or moving building materials are displayed in logging cars, lumber cars, flat cars, tip cars, and gondola cars. A lumber car is generally, but not always a box car, and it is usually of extra length,—about 34 feet. Logging cars are used extensively for transporting logs through portions of lumber districts to saw mills, where they can be converted into lumber. Prominent varieties are an extension reach eight-wheel logging car, with a capacity for carrying 3,000 feet B. M., weighing 6,200 pounds, height, 27 inches, length, 21 feet over all; and a flexible truck eight-wheel logging car with a capacity for carrying 1,500 B. M., a weight of 4,000 pounds, height, 24 inches, length, 21 feet over all; a flexible, frame lumber larry, having four wheels. The logging cars bear about the same relation to other cars that logging wagons bear to other wagons,—platforms and everything above platforms or floors being omitted.

The next stage of arrangement is represented by the flat car or platform car, in which there is nothing above the platform, and no obstacles to loading or unloading heavy articles, such as large stones, are presented. To prevent slipping or sliding off, stake pockets are provided on the sides of these cars in which stakes can be placed.

A flat or platform car is converted into a gondola car when boards rising above the level of the platform are attached to all its sides. There is a modern tendency to increase the number or height of such boards, and to rely upon a hopper-bottom rather than upon the removal of the boards from one of the sides of the car to facilitate unloading.

The tip car is a style extensively used in railway construction and sometimes for other purposes. It is usually four-wheeled, but sometimes eight-wheeled. One style of the latter weighs 13,000 pounds and has a capacity of 16,000 pounds. It combines the leading features of a gondola car with arrangements for tipping the body so as to let the load slide out, instead of discharging it through a drop-bottom. An improved style of tip car provides for slowly tipping the load by gearing.

The typical American freight car in general use, which is applicable to nearly all purposes already mentioned, either with or without a few temporary modifications, and also to the transportation of an immense variety of miscellaneous articles, including groceries, dry goods, hardware, and nearly all descriptions of merchandise, is the box car. Provided with a roof and strong sides, it affords thorough protection from the weather when in good condition, and is practically the only description of freight car used for the transportation of articles needing such protection which are not usually moved in cars embodying special features. A few four-wheeled box cars are used, but box cars nearly all have eight wheels, and one of the most important of the modern changes was to increase their capacity, which formerly rarely exceeded ten tons, and was subsequently increased to from twenty tons upward. There is a considerable diversity in the details and size of the box cars used by different leading lines, but an active general movement has been progressing for some years towards an increase of their size, strength, and capacity, and a diminution in the number and extent of the diversities in the details of their construction.

INCREASE OF THE CAPACITY OF FREIGHT CARS.

THE final result of many preceding and auxiliary movements was a notable increase in the size and capacity of freight cars, which was one of the most important agencies in promoting the economic movement of many products. Before the commencement of the eighth decade few of the freight cars of the country had a nominal capacity greater than ten tons, although heavier weights were often crowded into them; but it was scarcely considered safe or prudent to move loads exceeding ten tons in such cars as were then generally used. Years of effort, indeed, had been spent in establishing a ten-ton standard, the rise from a much lower level being slow and gradual. The conservative course pursued was largely due to the defective condition of many of the railroads, and soon after they were materially improved an extraordinary increase of the nominal capacity of a considerable number of freight cars was produced in a remarkably cheap and easy manner, being simply the work of the paint brush; that is to say, inscriptions on the body of cars announcing that their capacity was ten tons were superseded by figures setting forth that they could carry fifteen tons. Such a feat would scarcely have been possible if the practice of loading cars with greater weights than their designated capacity had not been extensively followed, and it was succeeded by changes in methods of construction which gave to a large proportion of the freight cars of the country an actual increase of capacity of from ten up to fifteen tons.

Statements bearing on this subject include the following:—

In an interesting paper "on the increased efficiency of railways for the transportation of freight," read by William P. Shinn, before the American Society of Civil Engineers, on December 20th, 1882, he said:—

"For many years, say from 1855 to 1876, the standard capacity of freight cars was 20,000 pounds, although much more was frequently loaded on a car. About 1877 a few cars were built to carry 30,000 pounds, and since 1879 the standard freight cars built for the principal east and west lines of railroad have been constructed to carry 40,000 pounds. I am informed that the Pennsylvania Railroad Company has ordered the construction of some cars having 50,000 pounds' capacity. This increased capacity is obtained by using a somewhat heavier car body, or 'cargo box,' with slightly heavier axles and journals. The comparative weight of a standard Pennsylvania Railroad box car, with its load, in 1870 and 1881, was as follows, viz.:—

	Weight of car.	Weight of load.	Total.	Load. Per cent. of total.
In 1870	20,500	20,000	40,500	$49\frac{38}{100}$
In 1881	22,000	40,000	62,000	$64\frac{52}{100}$
Increase	1,500	20,000	21,500	$15\frac{14}{100}$"

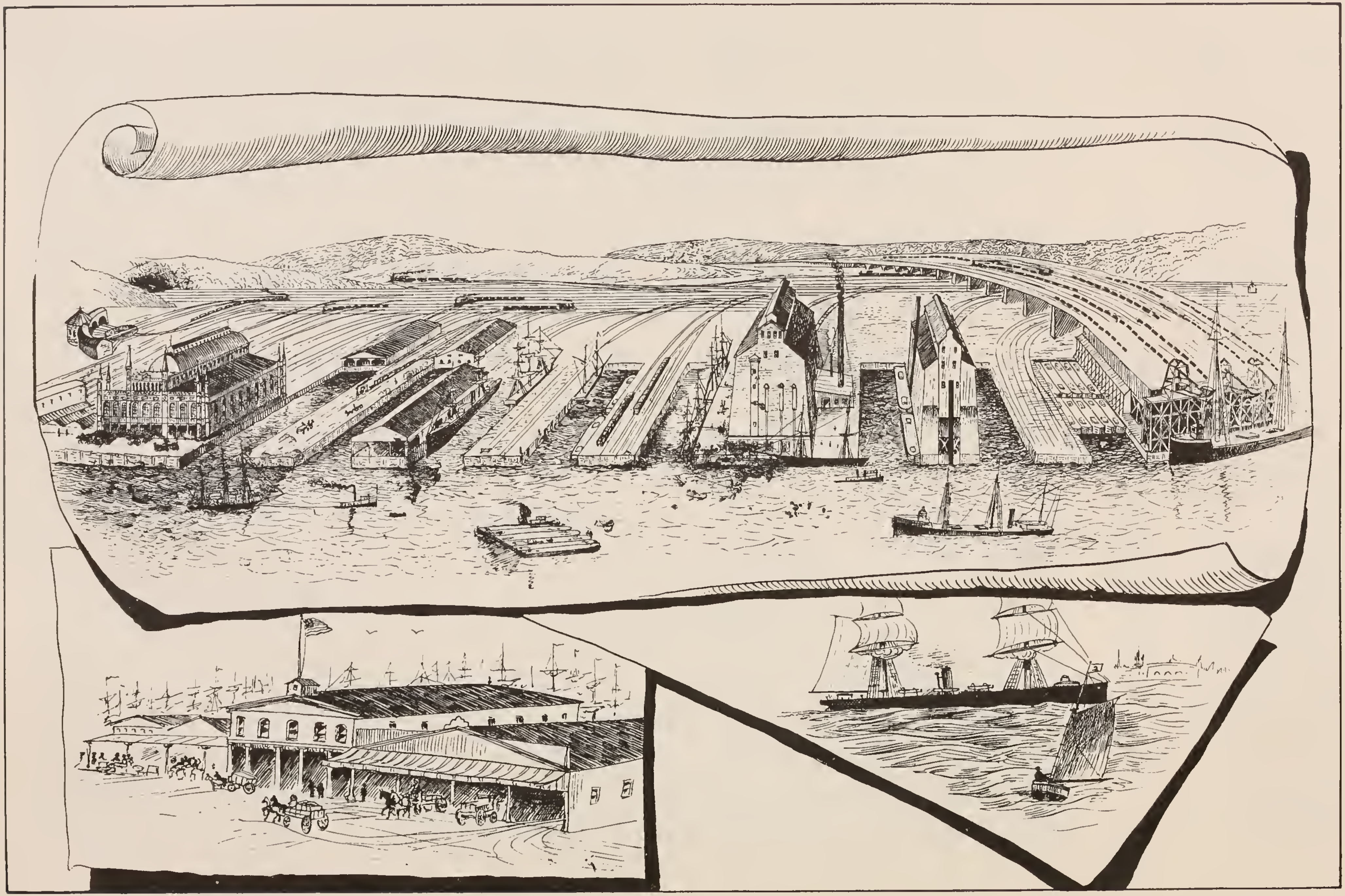
A comprehensive statement of the general railway practice of the country and of the economic advantages of an increase of the capacity of freight cars is contained in a circular issued by a committee of the Master Car-Builders' Association, dated March 30th, 1882, which was intended to elicit information from railway officials in regard to the advisability of increasing the capacity of freight cars above twenty tons. The following is an extract from this circular:—

"It is only a few years since freight cars were allowed to be loaded with more than ten tons. At the present time but few eight-wheel cars are built with a carrying capacity of less than twenty tons. From this fact we infer that twenty-ton cars can be run as safely as ten-ton cars, and that freight can be transported with greater economy in cars that have the greatest carrying capacity.

The increase of freight traffic upon our leading railroads during the last five years has been very large, and if it had been necessary to transport it in ten-ton cars the expenses for motive power and train men, cost of maintenance of the greater number of cars, &c., would have been enormous. Road-beds and bridges are made more substantial than in former years. Locomotives have of late been made of enormous weight and power, and such locomotives are so successful and satisfactory that railway managers still continue to build them. If these heavy locomotives can be run without serious injury to road-beds and bridges, are there any objections to increasing the load of freight cars when there are so many advantages to be gained thereby, with so few and trifling objections?

The following are considered a few of the most important advantages that may be derived in transporting any given amounts of tonnage in thirty-ton cars: Less cost of cars; less cost of repairs; less dead weight; less number of way bills to make; shorter trains; shorter side tracks; less coupling and uncoupling of cars, and damage to draw-bars and fixtures; less number of brakes to operate; less number of journal boxes to oil; less number of wheels to inspect; less train men, and many other smaller advantages."

At the present time (1888) box cars with a nominal capacity of twenty tons approximate most closely to the prevailing standard, but cars with a nominal capacity of twenty-five tons are not unusual, and some of 60,000 pounds nominal capacity are in use. A large proportion of the latter are gondola cars. It is probable that the practice of overloading is still followed not infrequently, and it occasionally results in making a twenty-ton car carry from twenty-five tons upward; a twenty-five-ton car carry more than thirty tons, and a thirty-ton car carry perhaps more than thirty-five tons. The extent to which such practices have heretofore been followed has been urged, in



TERMINAL FACILITIES.

annual conventions of the Master Car-Builders' Association, as a serious objection to a material increase of the nominal capacity of freight cars above twenty tons.

Other considerations bearing on this subject are presented in a report made to the annual convention of the Master Car-Builders' Association, held in 1883, and discussions it elicited. A committee which had addressed circulars of inquiry to numerous members stated that "all the replies agree that 40,000 pounds of load, not including the car, is all that can safely be put upon the present master car builders' standard axles and our present construction of freight-car equipment. They also agree that there are several conditions to be considered in this connection: (1) Our imperfect mode of lubrication; (2) the carrying capacity of bridges and track; (3) the tendency to increase the speed of freight trains. All combined make them very cautious as to what increase of carrying capacity to reccommend."

In the discussion of this report Mr. Wilder said: "In regard to the increased capacity of cars, it seems to me that we are running pretty nearly to the limit we can put on one vehicle. It is very hard work to get most of the freights offered to us into one of our 33-foot cars in a load of over 40,000 pounds, and we must increase the length of the cars if we carry more weight. I have had occasion to look into that matter very thoroughly, and with most of the different kinds of staple goods that are forwarded—pork, lard, and grain—you must load the present cars very nearly to the roof before you can get 40,000 pounds into them. Of course, with coal, iron ore, pig iron, and other materials of that kind, the load which can be carried in one of these cars is not so limited."

Mr. Wall said: "Some cars were built for the Pennsylvania Railroad of 50,000 pounds, which were of the same length as hopper gondola cars, with higher sides. We have not had any of those cars on the Pan Handle, and we do not expect to get any for some time to come. We found that we could not take cars of 50,000 pounds capacity and run them over bridges safely. You can take one car of 50,000 pounds capacity on almost any road, probably, in existence, that has a good roadbed, and take it over bridges, too. But there is another consideration, if you take two 50,000 pounds cars, and they are loaded, the points between the trucks will be very heavily loaded. That is, if you take the total wheel-base from the outside of one truck to the outside of the other on two adjacent cars, the weight per foot will be too great to run safely. If you take the total wheel-base under one car it will be all right, because that is distributed over, say, thirty feet, while the other is distributed in a length of probably sixteen feet, and we found, in investigating the subject, that it would not be safe to run them over our road."

At this convention a committee of seven was appointed to confer together and agree, if possible, upon a standard house car with details of all its parts, whose maximum load shall be 60,000 pounds. The agitation of the subject was continued at conventions held in subsequent years. At the convention of 1885 a committee appointed to report upon a standard house car to carry 60,000 pounds of lading, announced that they had agreed upon dimensions, which were described. In the discussion which followed several members stated that the roads with which they were connected had cars that carried 60,000 pounds, but that there was a good deal of trouble with them arising from heated journals and other wear and tear. At another convention several house or box cars of 60,000 pounds capacity, erected under the direction of a committee, were on a track near the place of meeting, subject to inspection. At the convention of 1887 a committee submitted plans of axle, journal box, journal bearing, and journal-bearing wedge for a standard freight-car truck and axle for cars of 60,000 pounds capacity.

The reports to the Master Car-Builders' Association, and the course pursued by those who built box cars with the increased nominal capacity showed that important changes in details of construction were considered desirable if not absolutely necessary. In a new 60,000-pound box freight car designed for the Michigan Central Railroad, by Robert Miller, master car builder of that company, the first specimen of which was built in November, 1886, both the body and trucks were considerably strengthened, in comparison with the usual style of 40,000-pound box car. The length of the car outside of the sills was increased to 35 feet, and additions were made to height and width, in comparison with usual standards, which increased the space available for receiving freight. The truss rods were arranged in a manner that materially strengthened the support of the floor.

In addition to the cars mentioned above, which are intended for extensive use, a side-dump car, with a nominal capacity of 40 tons, was constructed in 1887, for use on one of the branch lines of the Pennsylvania Company, for transporting ore from vessels to storage trestles.

Where special necessities require extraordinary strength, such as is needed for transporting heavy cannon or machinery, freight cars with a capacity exceeding 100 tons have been built. One of the latest cars of this description was built at the Packerton car shops, on the Lehigh Valley Railroad, in January, 1888. Its capacity was 120,000 pounds, and in a preliminary test it was loaded with 122,724 pounds of material. The dimensions were similar to those of an ordinary flat car. The body of the car was made much stronger than usual, and it was supported by two six-wheeled equalized trucks.

INCREASED SIZE OF PASSENGER CARS.

The increase of size and capacity, which forms such a notable and important feature of changes in freight cars, was to some extent accompanied with au increase of the capacity and weight of various portions of passenger cars. The following comparative statement of the details of passenger cars in general service in 1863 and in 1884 was published a few years ago:—

	1863.	1884.	P. ct. inc.	P. ct. dec.
Length of car body in feet	30	57	90	..
Seating capacity	44	77	72	..
Weight of car body	14,000	27,000	92	..
Weight of car trucks	13,000	18,000	37	..
Total weight of car	27,000	45,000	66	..
Weight of each wheel without load	3,375	5,625	66	..
Weight of load (passengers) on each wheel.	770	1,330	72	..
Total weight on each wheel when loaded up to its seating capacity	4,145	6,955	67	..
Weight of body to the foot	466	474	1	..
Weight of body and truck to the passenger.	613	592	..	3
Rate of speed under which brakes are applied in miles	12	24	100	..
Weight of 33-inch cast-iron wheel	540	540	..	..
Weight of 33-inch steel-tired wheel	...	687	..	..

DETAILS OF CAR CONSTRUCTION.

IN connection with the construction and operation of cars a number of interesting and complicated questions have arisen, and on their judicious solution much has depended. Methods of manufacturing or arranging nearly everything of material importance relating to cars have frequently been in a transition state, on account of the multiplicity of new inventions pertaining to such matters, diverse views of numerous railroad companies and heads of car-building establishments, and the strong desire manifested in many quarters to cheapen the cost of moving freight by every available mechanical device, and to add to the safety and attractiveness of cars used in competitive passenger traffic.

One of the fundamental points involved in the consideration of questions affecting freight cars is the best method of securing an advantageous relation between dead and paying weight. It may be desirable for one company to adopt a course which would not be conducive to the interests of other organizations employing their equipment chiefly in moving different products, and it may be desirable to increase the capacity of some classes of cars and not of others.

The efforts of the Master Car-Builders' Association to promote uniformity have led to the establishment of standards for some of the parts of freight cars, and this is one of the most important fields of persistent labor. Others relate to automatic freight couplers, freight train brakes, methods of heating passenger cars with steam obtained from locomotives, brakes, brake-shoes, couplers, trucks, journal boxes, journal bearings, springs, wheels, axles, draw-bars, dead blocks, methods of framing cars, and methods of lighting and ventilating passenger cars.

The net result of an immense amount of labor has been such a great improvement over old devices, that one of the serious difficulties of late years has been to choose between a multiplicity of meritorious inventions. The progress made in improving details of car construction is a feature of general advancement which has contributed much to industrial prosperity and the personal comfort of travelers, and in this great work the United States has taken the lead of all other nations.

PREMIUMS FOR CAR APPLIANCES OFFERED BY THE CHICAGO RAILWAY EXPOSITION.

An indication of the classes of articles used in car construction which are made by numerous manufacturers is furnished by the following lists of things for which premiums were offered by the Chicago Railway Exposition of 1883:—

Running Gear.—Best steel axle, best iron axle, best hollow axle, best passenger-train brake, best freight-train brake, best brake shoe, best springs (elliptic), best springs (spiral), best springs (bearing), best springs (buffer or draw), best springs (rubber), best equalizing spring, best draw-bar for freight car, best journal box, best journal-box lid, best journal bearing, best steel tire for car wheels, best steel-tire metal wheel, best car iron wheel, best steel-tire combination wheel, best car step, best passenger-car platform, coupler, and buffer, best passenger-car six-wheel truck, best passenger-car four-wheel truck, best freight-car truck, best automatic freight-car coupler, best freight-car coupler (non-automatic).

Interior Furnishings for Passenger Cars.—Best display, best bell-cord fixtures, best bell cord, best car-door butts, best car-door latch (saloon), best car-door lock, best seat end, best seat-end lock, best seat-end fixtures, best curtain goods, best curtain roller, best curtain-rod fixtures, best deck-light catch, best display of car lamps, best centre lamp (one burner), best centre lamp (two burners), best centre lamp (three burners), best centre lamp (four burners), best electric light for cars, best postal-car lamp, best side lamp, best door, window, and deck glass (illuminated), best heater, best stove, best head lining (cloth), best head lining (wood), best hopper, best urinal, best window lift, best sash lock, best deck-light opener, best decorating material, best sash, best window blind, best window-blind lift, best sash spring, best sash stop, best seat frame, best upholstering, best system of ventilation, best dust guard, best display fancy woods and veneers, best water cooler, best berth and seat springs, best berth curtain hook and fixtures, best wash-room pump, best cooking range, best reclining chair, best revolving chair, best washstand for parlor or sleeping car, best basket rack, best door holder, best door knob, best coat hook, best hat hook, best cuspidor or spittoon, best headboard and fixtures (for sleeping car), best folding bed for car, best curtain-rod bracket, best double-acting hinge, best electric or other call bell.

Freight-Car Appliances.—Best car seal, best car replacer, best car pusher, best grain-car door, best freight-car door, best end-door inside fastener, best freight-car lock, best door hanger, best metal roofing, best wood roofing, best combination roofing.

THE NOTABLE IMPROVEMENTS IN CAR CONSTRUCTION

are based on progressive changes relating to many details, each of which has received much attention from many intelligent mechanics and inventors. The two grand divisions of a car are the body and trucks. The brake gear and draw gear are considered part of the details of the body. In box freight cars these details include framing, grab irons and ladders, roofs, doors, locks, and seals. In passenger cars details of the body include a number of articles classified under the general head of furnishings, such as basket racks, bell cord and appliances, doors and aids for opening, shutting, and fastening them, gas fixtures, lamps, seats, curtain fixtures, stoves and heaters, ventilators, lavatories, windows, &c. There are hundreds of names for the different portions of the bodies of cars and articles used in their construction. Truck details include axles, brake shoes, journal bearings, journal boxes, pedestals, side frames, side bearings, spring swing links, and wheels. There are more than one hundred parts of some trucks. Changes of varying significance are frequently made, and sometimes they represent notable improvements, in many of the details of bodies and trucks.

MATERIAL AND LABOR REQUIRED TO BUILD A BOX CAR.

The following itemized list of the material and labor required to build a box car was furnished by William Kinyon, master car builder of the Western and Atlantic Railroad Company, to Eugene C. Spaulding, car accountant of that company, in 1886. It was described as a first-class box car, but capacity was not stated:—

Material and Labor in Body of Car.

Articles.	Rate.	Amount
3,987 feet lumber	2 cents per foot	$79 74
704 pounds wrought iron	5 cents per pound	35 20
606 pounds cast iron	3 cents per pound	18 18
100 pounds nails	4 cents per pound	4 00
6 pounds plat washers	6 cents per pound	36
10 pounds lag screws	7 cents per pound	70
½ gross 1½-inch screws	30 cents per gross	15
46 pounds steel springs	9 cents per pound	4 14
160 sheets tin	7 cents per sheet	11 20
8 pounds solder	15 cents per pound	1 20
2 pounds tin nails	10 cents per pound	20
28 pounds mineral paint	1 cent per pound	28
4 gallons linseed oil	75 cents per gallon	3 00
20 days carpenter's labor	$2.25 per day	45 00
2 days tinner's labor	2.00 per day	4 00
1½ days painter's labor	2.00 per day	3 00
Total in body		$210 35

Material and Labor in Pair Trucks of Car.

Articles.	Rate.	Amount.
487 feet lumber	2 cents per foot	$9 74
1,000 pounds wrought iron	5 cents per pound	50 00
1,306 pounds cast iron	3 cents per pound	39 18
184 pounds steel springs	9 cents per pound	16 56
64 pounds brasses	22 cents per pound	14 08
4 pairs wheels	$40 per pair	160 00
4 pounds mineral paint	1 cent per pound	4
½ gallon linseed oil	75 cents per gallon	38
¼ gallon asphaltum	$1.50 per gallon	37
Carpenter's labor		5 65
Painter's labor		50
Total in trucks		$296 50
Total in body		210 35
Total in both or one car		$506 85

MATERIAL AND LABOR REQUIRED TO BUILD A STANDARD PASSENGER CAR IN 1876.

Dredge's account of the Pennsylvania Railroad gives the following itemized statement of materials used and cost of labor in constructing a standard passenger car at the Altoona shops in or about 1876:—

Labor	$1,263 94
Proportion of fuel and stores	28 61
Proportion of superintendent, chief clerk, and storekeeper's time	13 53
2,480 feet poplar at $35 per 1,000	86 80
3,434 feet ash	127 08
1,100 feet pine at $19	20 90
2,350 feet yellow pine at $30	70 50
500 feet oak at $20	10 00
450 feet hickory at $30	13 50
700 feet Michigan pine at $70	49 00
400 feet cherry at $40	16 00
439 feet maple veneer	24 14
4 pairs wheels and axles	332 85
2 pairs passenger car trucks complete	533 62
87 pounds color at 15 cents	13 05
13 pounds putty at 12 cents	1 56

59 pounds Hunter's paint at 12 cents	$7 08
35 pounds oil filling at 12 cents	4 08
49 pounds filling at 13 cents	6 37
15 pounds Tuscan red	3 75
2½ pounds drop black	0 70
2 pounds lamp black	0 34
2 pounds green	0 32
Gold bronze	2 76
6 pounds pulverized pumice stone	0 36
1 quart olive oil	0 58
3 quarts black varnish	1 17
1 quart shellac	0 66
3 gallons varnish at $4 68	14 04
10 gallons varnish at $3.83	38 30
1 gallon linseed oil	0 59
45 pounds glue	14 33
23 pounds white lead	2 59
2,925 pounds iron	87 75
Nails	2 25
72 pounds square nuts	5 05
158 pounds nails	5 52
Brass wire and small nuts and washers	0 41
792 pounds castings	16 99
2 pounds spring steel	0 17
9 pounds washers	0 63
6 pounds hexagonal nuts	0 60
119 pounds wagon box iron	5 59
Wood screws	4 05
Screws	51 88
31 pounds carriage bolts	0 45
1 set gas pipes, &c	7 19
Gas burners	0 22
Brass connections	0 25
1 gas regulator	15 00
1 gas gauge	10 25
2 two-light chandeliers	50 72
1 gas bracket	3 09
2 gas tanks complete	84 00
2 soldered joints	0 40
1 air brake complete	131 79
1 water cooler faucet	3 25
8 pounds lead pipe	0 80
1 pound chain	0 04
Screw eyes	0 05
57 sash balances	44 61
27 pounds rubber draught packing	12 65
31 lights, white glass	26 11
2 lights, plate glass	10 56
25 lights, ruby glass	27 72
3 extra lights	1 44
Wood filling	0 13
12 vertical registers	8 32
2 stoves	77 56
50 seat arms	8 50
2 bronzed sash fasteners	4 84
2 bronzed sash fasteners	3 70
20 brass alcoves	3 77
25 sets of seat fixtures	50 50
2 bronze notice plates	4 00
4 notice frames and notices	2 44
3 bronze lamps	13 50
2 bronze door locks and fittings	15 20
1 saloon door lock	6 26
3 lamp "canopies"	2 43
3 pairs bronze butt hinges	5 41
1 pair 3 inches by 3 inches bronze butt hinges	2 43
1½ inch by 1½ inch brass butts	0 24
2½ pairs iron butts	0 13
26 pairs brass butts	7 37
1 drip pan	5 06
1 urinal	4 25
1 W. C. tube	6 30
3 seven-inch ventilator rings	2 43
2 brass bushings	0 28
5 leather bell-cord hangers	6 50
2 bronze bushings	0 44
2 ten-inch ventilator rings	2 44
1 eight-inch ventilator ring	0 52
1 three-inch ventilator ring	0 44
13 bracket racks	77 35
12 sash levers	42 00
2 door holders	3 00
61 bronze window lifts	24 40
61 bronze window fasteners	16 47
94 bronze window stops	8 14

2 coat hooks	$0 05
3 match lighters	1 17
1 waste cock	1 85
172 sheets tin 20 inches by 28 inches	34 17
66 sheets tin 14 inches by 20 inches	6 27
272 pounds galvanized iron	25 31
14 pounds solder	2 24
2 pounds rivets	0 32
6 pounds tinned nails	0 76
5 square feet wire gauge	0 30
52 pounds No. 12 sheet iron	2 73
4 pounds nails	0 24
Pins, &c	0 68
2 yards brown muslin	0 98
34 yards hat cord	4 08
Burlap sacking	0 09
96 yards scarlet plush	228 87
44 yards plain green plush	109 99
61 yards sheeting	10 30
15 yards buckram	3 79
52 yards flax canvas	8 32
1 yard 8 oz. duck	0 18
14 yards cocoanut matting	7 22
1 bell rope	1 44
½ pound thread	0 98
Tinned tacks	0 14
1 pound brass washers	0 20
12½ yards 10 oz. duck	3 56
2 yards 6 oz. duck	0 53
1½ yards ship canvas	0 16
Seaming cord	0 04
5 gross plush nails	3 33
5 gross plush buttons	2 82
1½ pounds tufting twine	0 78
1 pound spring	0 23
213 pounds hair	72 95
Tacks	3 68
12 springs	22 96
12 spiral elliptic springs	20 29
22 spiral springs	0 92
2½ pounds lining nails	0 50
1 head lining	80 63
Flour	0 15
½ gallon sample varnish	2 37
2 packets gold leaf	14 58
3 gallons alcohol	7 81
Beeswax, &c	0 46
4 pounds sole leather	1 28
26 quires sand paper	5 72
	$4,423 75

PORTIONS OF CARS SPECIALLY LIABLE TO WEAR AND TEAR.

Neither of the above lists furnish an adequate idea of the portions of cars peculiar to those vehicles, which are specially subject to wear and tear, or breakage. Many of the repairs of freight cars must be made on foreign roads, and the wide range formerly given for diversity of patterns led to a lack of uniformity which became a serious evil or inconvenience after the practice of interchanging cars, or sending the cars which belonged to one company over the roads of connecting lines, became common. One of the leading objects of the Master Car-Builders' Association was to diminish this diversity, or to promote uniformity. A circular directing attention to this subject, issued by a committee of that body in 1882, said:—

"It is, of course, impossible for this committee to anticipate all the work which the car-builders' association may advantageously do in the future. It can be said, though, that if sufficient uniformity in the construction of cars could be brought about it would result in the saving of hundreds of thousands of dollars annually to railroad companies. To show how great the diversity still is, the committee requested several car builders to give the number of different duplicate parts which they are now obliged to keep on hand at certain points for the repair of foreign cars.

Mr. Adams, master car builder of the Boston and Albany Railroad at Boston, writes:—

'We have about forty different kinds of brake-heads and shoes, eleven different journal boxes, thirty-seven journal bearings, ten cast-iron and five or six wrought-iron draw-bars, eight or ten different draw-bar side castings and a multitude of various other kinds of differeut parts of cars.'

Mr. Packard, master car builder of the Baltimore and Ohio Railroad at Baltimore, says:—

'The list I give you is from the patterns we use at this point and distribute to other points where interchanges of other cars are made. We also have to order a great many from different roads when we have not the patterns to make them from, which would increase this number very materially if we had the patterns for every one we use. I submit the following, viz.: 65 different kinds of journal bearings, 25 different kinds of journal boxes, 25 different kinds of journal-box covers, 20 different kinds of brake-shoes, 22 different kinds of brake-heads, 12 different kinds of brake-hangers, 6 different kinds of axles, 8 different kinds of draw-bars, 10 different kinds of draw-bar follower plates, 15 different kinds of draw-bar springs, 8 different kinds of draw-bar stop castings, 10 different kinds of side bearings.'

Mr. Verbryck, master car builder of the Chicago, Rock Island and Pacific Railway at Chicago, reports:—

'We have five kinds of journal boxes on our road, and I have patterns for three kinds of New York Central and Hudson River and the Master Car Builders' standard. But in looking over my orders for the last year I find I have had to order forty-six different kinds of journal boxes, besides the kinds I have cast for repairs of foreign cars broken on our line, and miscellaneous castings for sixty different kinds of cars, wrought iron draw-bars for forty-four different kinds, and eight or nine kinds of cast iron. I have fifty-four different patterns of journal bearings, and have had to buy thirty-five different kinds besides during the year. I cast five kinds of brake heads and shoes, and have bought forty-three different kinds more. Springs, side bearings, and follower plates I cannot tell how many kinds I have used, but they are about as numerous as the different kinds of foreign cars that are run over our line.'

The master car builder of the New York Central Railroad at Buffalo gives the following list of different kinds of parts which must be kept on hand at that point: 56 different kinds of axles, 46 different kinds of journal bearings, 2 different kinds of journal-box covers, 58 different kinds of journal boxes, 24 different kinds of draw-bar follower plates, 22 different kinds of brake hangers, 26 different kinds of draw-bars, 8 different kinds of draw-bar stops, 27 different kinds of brake heads, 20 different kinds of brake shoes, 10 different kinds of side bearings.

At a recent meeting of car builders, Mr. W. W. Snow, who is engaged in the manufacture of brake shoes, reported that he had 182 different patterns at his works, which had been sent as samples to manufacture from, and that at the present time there are not less than 300 different kinds in use in the whole country.

The parts enumerated are only a few of those used in the repair of cars, and if they were all named it would increase the lists to enormous proportions. A similar condition of things to that indicated by the few reports given exists wherever any considerable number of cars are interchanged from one road to others.

Not only is an enormous expense thus incurred by keeping immense quantities of what may be called dead supplies on hand, but the cost of making repairs is very much greater than it would be if the cars were more uniform in construction, and, what is worse, traffic is greatly delayed thereby."

MASTER CAR-BUILDERS' STANDARDS.

The list of standards recommended for adoption by the Master Car-Builders' Association up to May, 1887, includes the folowing:—

A standard form of wheel tread and flange.

A standard wheel gauge.

A standard car axle.

Standards for journal bearings, journal boxes, and pedestals.

A standard brake head and shoe.

A standard system of screw threads, bolts, and nuts.

A standard of sizes for limit gauges for round iron.

A standard for height, attachments, and dimensions of draw-bars, and for capacity of draw-springs.

Standard dimensions of dead blocks.

Standards for positions of brake shafts, brake steps or platform, and fastening of brake ratchet wheel and pawl, running boards, wrought-iron steps of freight cars, ladder, and handles.

An endorsement of truck and car-body chains as part of passenger equipment.

A standard system of making cars.

A standard system of lettering and numbering fast freight-line cars.

THE BATTLE OF THE BRAKES.

THE power to suddenly arrest train movements is only second in importance to the ability to make them. It is for many purposes as essential that the brake should stop a running train suddenly as that the locomotive should propel it rapidly. Few, if any, problems connected with the mechanical branches of railways have attracted more serious attention than those relating to brakes, and there are probably none on which a greater amount of ingenuity has been exercised, or a closer approach made to the attainment of desirable ends.

In the United States special exertions in this field of effort were rendered necessary by a number of circumstances, such as the abundance of grade crossings and heavy grades, which made it more important, if possible, here than elsewhere, that effective brakes should be invented and applied. The response to this requirement has been so creditable that superior means of meeting all native necessities have been provided, and the most important portions of the brake power of all the progressive railways of the world are now based on American models.

For many years hand brakes constituted the sole reliance for stopping trains; and a great variety of hand-brake methods and appliances have been pressed into service, and are still in use on freight trains. Their best forms represent an immense advance upon the primitive brake apparatus, and include embodiments of some of the most useful of railway inventions.

But the desirability of brake systems that are under the control of locomotive engineers has long been recognized, as they enable the person who is generally the first to see danger and the first to know that a quick stoppage is desirable for any cause, to promote that object by his individual efforts instead of being obliged to call for the assistance of a number of brakemen who may not promptly respond, and who, even when they speedily put forth their best efforts, cannot be expected to stop a train as quickly as it can be stopped by an effective continuous train brake.

The importance of such an appliance, as an attachment to passenger trains, was clearly pointed out some years before efforts to provide it were successful. Then came an era when the advantages of continuous train brakes, in their application to passenger trains, were so clearly apparent that their use became practically universal in this country, and was extended to nearly all other civilized nations. This stage of progress was intermingled with the invention and extensive use of a great improvement on the first of the leading continuous brakes, which is represented by the difference between the Westinghouse air brake (non-automatic) and the Westinghouse automatic brake. The period when the advancement described above was attracting most attention as a progressive movement was between 1870 and 1880.

Shortly after the commencement of the ninth decade efforts to secure the application of continuous brakes to freight trains were initiated in the United States, but they proceeded somewhat slowly until about the middle of the decade, when the subject began to attract much attention, and since that time interest in it has been so much increased that a leading event of 1887 was the triumphal tour over a number of important American railways of a train of fifty freight cars, equipped with an improved style of the Westinghouse automatic freight-train brake, and practical demonstrations, in the vicinity of a number of populous cities, and in the presence of thousands of critical spectators, of the fact that this brake not only fulfilled the conditions desirable in a freight-train brake, but also embodied improvements which rendered it more efficient than any of the pre-existing passenger-train brakes.

It would be difficult to exaggerate the importance of these achievements. The advance steps were made in competition with numerous devices, some of which possessed great merit, and competitive struggles, in this and other countries, were conducted under such imposing circumstances that they were aptly termed "The Battle of the Brakes."

NECESSITY OF CONTINUOUS TRAIN BRAKES ON PASSENGER TRAINS.

Formerly trains usually moved at low rates of speed, and they generally consisted of a comparatively small number of cars, so that it was not a matter of much consequence whether they could be quickly stopped or not; but after passenger trains commenced running at relatively high rates of speed many accidents happened that could have been averted by effective continuous brakes, and it became evident that they were necessary adjuncts, on many roads, of any serious effort to gratify the public demand for rapid transit, and to combine it with safety.

To illustrate the importance of prompt stoppages, and the difficulty of securing them, various statements have been made. It is said that in one second a train traveling at 60 miles an hour passes over 88 feet; at 45 miles an hour, 66 feet, and at 30 miles an hour, 44 feet. The time required to move over a distance of 100 yards is 3.4 seconds if the train is running at a speed of 60 miles an hour; 4.6 seconds if the train is running at a speed of 45 miles an hour, and 6.8 seconds if the train is moving at a speed of 30 miles an hour. The difficulties to be overcome in securing a quick stoppage, after the locomotive engineer endeavors to stop the engine, arise chiefly from the momentum of the train, which varies with its weight, the speed at which it was progressing, and the grade of the line on which it was moving. Captain Douglas Galton, in a discussion of this subject, stated that "a train, through the locomotive, slowly accumulates energy, and for each ton of weight in the train the accumulated energy is equal to 120 foot-tons at 60 miles per hour, 53 foot-tons at 40 miles per hour, and 13 foot-tons at 20 miles per hour. Thus for a train of 15 vehicles, weighing 200 tons, the energy at 60 miles per hour is equal to 24,000 tons falling a distance of one foot, or approximately to the energy of a shot from the 80-ton gun."

Scientific experiments in England, made in 1875, demonstrated that with the hand brakes then in use a train of a locomotive and 13 cars moving at a speed of 45 miles an hour could not be brought to a stand in less than one minute, or before the train had traversed a distance of half a mile. Several distressing accidents in this country taught a similar lesson.

The difference between the magnitude of the calamities that may be caused by a train plunging madly onward for such a distance, after the locomotive engineer plainly discerns danger, and the catastrophes that would occur if the train could be stopped in a few seconds of time and the space of a few hundred feet, represent the gain derived from the use of an effective continuous brake. The arguments in favor of the application of such a life-saving appliance to passenger trains are overwhelming. The first device that was extensively introduced was the Westinghouse air brake (non-automatic). The fact that the agency used in applying brakes was then somewhat novel, as it consisted of compressed air, and that it required appliances which sensibly increased the complications connected with locomotives and car movements were serious obstacles to its universal use. Another difficulty arose from the fact that it did not fill all the requisite conditions. Two important deficiencies consisted first, in the liability of the brake to occasionally fail, even when it received such attention as was commonly bestowed upon it; and second, in its inability to provide for a sudden stoppage of the train by other agencies than appropriate movements of the locomotive engineer. For these reasons the original Westinghouse air brake, although it long continued to be in extensive use, and is still used by a number of roads; and, although it has doubtless been the means of saving many lives, and of preventing the destruction of much property, did not fully meet all the desirable conditions, and it was, therefore, supplemented, in a large degree, by

THE WESTINGHOUSE AUTOMATIC BRAKE.

A protracted discussion in England of the qualities that a continuous brake should possess finally led to the extensive adoption, by the railways of that country, and of continental nations, of the Westinghouse automatic brake after numerous animated competitive struggles with rival brake systems. The result was chiefly due to a conviction that it more completely fulfilled the desirable conditions than any other known device. One of the best statements of those conditions is the following, published in Engineering of December 15th, 1876:—

"The main requirements to be sought for in selecting a railway brake which may be placed with confidence upon high-speed trains may be summarized as follows:—

1. It must be capable of application to every wheel throughout the train, if so desired.

2. It must be so prompt in its action that no appreciable loss of time occurs between the time of its application, and the moment when its full power can be exerted throughout the train.

3. It must be capable of being applied by the driver of the engine, and at any desired point throughout the train.

4. It must be capable of application by driver and guard acting in concert, or by either independently of the other.

5. It must under all circumstances be capable of arresting the motion of a train in the shortest possible distance.

6. It must be so arranged that in the event of the failure of any one of its vital parts, such failure must record itself by the application of the brakes or otherwise; so that the train, if in motion, may be automatically arrested, and the existence of a defect be thereby made known.

7. It must, in the event of a train breaking into two or more parts, be capable of immediate automatic application to every vehicle, under all conditions.

8. It must be simple in its construction and in its mode of working, and not be more liable to derangement in any of its parts than any other portion of the mechanism on the train.

9. The duties it is called upon to perform must be done by the apparatus itself, and not by the addition of any auxiliary contrivance called in to aid an appliance which cannot of itself fulfill the necessary conditions.

10. It should preferably be inexpensive for first establishment, and necessarily cheap in maintenance, for if the latter condition be not fulfilled, constant watching and frequent renewals would be required, and the eighth requirement named above would not be complied with."

A leading feature of the Westinghouse automatic brake is an arrangement by which the force employed must always be in good condition to prevent the application of the brakes. They become operative in retarding or preventing advance movements the instant they are seriously out of order, or when any important exceptional influence affects the train movement, and they can also be applied by the conductor, brakemen, or other employé in any of the cars, or by the locomotive engineer. In brief, the brakes are only kept off the wheels by forcible pressure of compressed air, and any sudden reduction of pressure in the brake pipe, whether it is produced by defects, accidents, conductors, brakemen, or the engineer, applies the brake. The essential parts of the machinery by which these results are achieved are stated, in a pamphlet issued by the Westinghouse Brake Company, to be as follows:—

"1. The steam engine and pump, which produce the compressed air.

2. The main reservoir, in which the compressed air is stored.

3. The engineer's brake valve, which regulates the flow of air from the main reservoir into the brake pipe for releasing the brakes, and from the brake pipe to the atmosphere for applying the brakes.

4. The main brake pipe, which leads from the main reservoir to the engineer's brake valve, and thence along the train, supplying the apparatus on each vehicle with air.

5. The auxiliary reservoir, which takes a supply of air from the main reservoir, through the brake pipe, and stores it for use on its own vehicle.

6. The brake cylinder, which has its piston rod attached to the brake levers in such a manner that, when the piston is forced out by air pressure, the brakes are applied.

7. The triple valve, which connects the brake pipe to the auxiliary reservoir, and connects the latter to the brake cylinder, and is operated by a sudden variation of pressure in the brake pipe (1) so as to admit air from the auxiliary reservoir to the brake cylinder, which applies the brakes, at the same time cutting off the communication from the brake pipe to the auxiliary reservoir, or (2) to restore the supply from the brake pipe to the auxiliary reservoir, at the same time letting the air in the brake cylinder escape, which releases the brakes.

8. The couplings, which are attached to flexible hose, and connect the brake pipe from one vehicle to another."

AUTOMATIC FREIGHT-TRAIN BRAKES.

After the use of heavy freight cars, carrying large loads, became common, and a considerable number of such cars were frequently coupled together in a single train, the desirability of applying continuous brakes to freight trains increased, especially on lines which wished to make rapid movements, or which were so located that they interchanged cars with few other roads. About 1883 the Central Pacific, Union Pacific, Atchison, Topeka and Santa Fe, and Northern Pacific contracted with the Westinghouse company for continuous train brakes to be applied to all their equipment, and numerous freight trains, supplied with continuous brakes, were soon afterwards running west of the Missouri. A few trains east of the Mississippi were also furnished with continuous brakes, but they were chiefly live-stock trains. The problems involved were especially intricate in connection with the operations of railways east of the Mississippi on account of the great extent to which they interchanged cars. The subject began to receive considerable attention from the Master Car-Builders' Association. At their annual convention held in 1885 a report on the subject was presented. It stated that the types of automatic brakes then being pressed on the attention of railroad companies for freight equipment might be classified under four general headings, viz.: 1. Buffer brakes. 2. Friction brakes. 3. Air brakes. 4. Electric brakes. Of these the only kinds then in comparatively extensive use were of the first and third varieties, 2,815 freight cars being then equipped with the American brake, classed as a buffer brake, 24,243 with the Westinghouse automatic, and 6,806 with the Westinghouse non-automatic.

Elaborate investigations and competitive tests, under the direction of the Master Car Builders, followed this report. A series of competitive trials were made near Burlington, Iowa, in the spring of 1886, which were followed by similar tests in 1887. They probably embodied the most extensive competitive investigations of the brake question that were ever made. One of the most important results was the invention of improvements of the Westinghouse automatic freight-train brake, which enabled it to meet the original requirements, and to perform extraordinary feats in the way of stopping a train of fifty freight cars.

In the closing months of 1887 practical proofs of the efficiency of the new system were furnished to large audiences of railway experts assembled at points near a number of leading cities. The average results of eleven of these tests were summarized in the following statement:—

"A train of 50 cars of a total length of 1,900 feet, weighing about 1,700,000 pounds, running 20 miles an hour, can be stopped by the use of hand by five men, all ready, and under the most favorable circumstances, in 1,563 feet.

By the air brakes, the same train, running at the same speed, can be stopped in 171 feet, or less than one-ninth the distance required by hand brakes. As in cases of genuine emergency the air brake is ready for immediate action, and the brakemen never are, it is fair enough to say that the air brake stops the train in one-tenth the distance required by hand brakes.

The same train, running at a speed of 40 miles an hour, is stopped by the air brakes in a distance of 646 feet.

These stops are made with the braking power low, as it is to be used, in ordinary service, so that it will not slide the wheels of empty cars. With the braking power increased so as to make the quickest possible time, regardless of sliding the wheels, a train of 20 cars, running at 20 miles an hour, is stopped in 96.7 feet, and running 40 miles an hour is stopped in 388 feet."

Interesting statements relating to the particular changes made in improving the Westinghouse brake, and also to other matters relating to brakes, are contained in an address delivered before the New York Railroad Club, in January, 1888, by H. H. Westinghouse, from which the following is condensed:—

"In the tests at Burlington, the necessity for substantially simultaneous action of the brakes on all of the cars to prevent shocks in the rear portion of the train, particularly when quick stops are required, was made so apparent that it was seen that a freight-train brake could not come into general use without possessing that virtue. After considerable effort the desired result was accomplished, as was fully demonstrated by the running of the 50-car freight train over the country under requirements approximating as nearly as possible those obtaining in ordinary practice; and in some respects the conditions were extraordinary. The cars were 38 feet 4 inches long, and the length of the whole train, which included a Pullman hotel car, was equal to 60 ordinary freight cars; so that the demonstration may be said to have been made upon a train of 60 rather than 50 cars.

It would be tedious, if possible, to accurately describe in detail the modifications that were made in order to bring the brake to its present state; but in general it may be said that the combination of two improvements was the principal agent. The first was the enlargement of all the air pipes and passages, and the second was the addition of a valve to the present triple valve, which is so arranged that, for purposes of emergency stops, the air in the train pipe is admitted directly to the cylinder, instead of passing out of the valve on the locomotive. In this way a practically instantaneous reduction of the pressure in the train pipe is brought about throughout the entire length of the train, and the pressure of the auxiliary reservoir is augmented by that in the train pipe, resulting in an increased pressure and promptness of action that combine to make the brake very powerful and uniform in its action. Particular attention is called to the fact that the quick action is principally brought about by the addition of a valve which does not modify the existing triple valve, and also that the improved brake has the triple valve in substantially the same shape as the one now in common use throughout the country. The emergency or quick-acting part of the valve is not operative, and performs no functions, except in cases of emergency, the present triple valve doing all the work of graduated braking. It is, therefore, apparent that the new brake will work in perfect harmony with the apparatus now in use. The presence of a quick-acting valve in a train fitted principally with the old valves will have a beneficial effect, for, in cases of emergency, it discharges some of the air from the train pipe into its cylinder, and thus quickens the action of the other valves. It is important that this feature of the improvement should be thoroughly understood, as otherwise it might be imagined that it would be necessary to immediately change the existing brakes in order to have them work in connection with the improved form.

One point of advantage came with the new brakes that was unexpected and very desirable. Noting that it is only in emergency stops that the air from the auxiliary reservoir is increased by the addition of the train-line pressure, it becomes plain that the greatest force is brought against the wheels at the proper time; that is to say, in cases of emergency and when quick stops are necessary. With the new brake, the power will be based upon the combined pressures of the train pipe and auxiliary reservoir. The increase of pressure due to the assistance from the train-line pipe is about 20 per cent., and, therefore, in regular practice, the available force to make service stops will be 20 per cent. less than in cases of emergency. There can be no question that this will to a great degree prevent sliding of wheels, as it is almost impossible to lock them, except the emergency brake is applied. If flat wheels should then be found in the train, it will be from one of two causes; either the engineer will have applied the emergency brake for ordinary stops, which is reprehensible, or it will have been caused by emergency stops, in which case the flattening of wheels or anything else, that would contribute to the stopping of the trains is justifiable.

It is well known that, when air is admitted to the cylinder and the piston moves out, the air-brake part of the apparatus has performed its functions, but if the connecting mechanism from the cylinder to the brake shoe is inadequate for the work, it is obvious that it is a matter of but little importance whether air passes into the cylinder or not, and in plain terms it may be stated that, unless cars are fitted with a good brake gear, it is a waste of money to put on any power apparatus to operate a poor one. That much of the brake rigging that is now employed on freight trains is not fit for use in connection with hand brakes, is beyond question. How utterly useless then is any attempt to use such rigging in connection with a device that exerts an instantaneous and tremendous force!

The putting of power brakes on freight trains means at once an increased speed for such trains, and a consequent much greater use of the brakes, and every consideration demands that this very important part of the brake apparatus should receive the most careful and mature consideration. The Westinghouse Brake Company, Limited, operating in Europe, have had an extended experience in fitting up brake rigging. None of the passenger cars abroad formerly had brakes of any kind, and when power brakes came to be applied the work involved brake beams, shoes, and rigging, as well as the air mechanism. The cost of wood precluded its use in brake beams, and, consequently, iron has been employed entirely, and many forms and shapes of head gear, especially brake beams, have been tried. Our 50-car freight train had an iron beam of a construction that will recommend itself on account of its simplicity and great strength. Some defects in the minor details were made apparent during the trip of the train. These have been remedied, and we are now desirous of having the features of this beam examined with a view to the general adoption of whatever good points they present."

CAR WHEELS AND AXLES.

THE manufacture of car wheels is an important and extensive industry. A list of car-wheel manufacturers in the United States and Canada, in June, 1887, enumerated 118 men, firms, or companies, a large majority of whom made a specialty of car wheels, but in some instances they were also car manufacturing firms or companies engaged in other auxiliary or affiliated industries. The principal portion of all the car wheels made in this country are now, and always have been, chilled cast-iron wheels, but the manufacture of various forms of steel-tired wheels, intended for use under passenger cars and some classes of fast freight cars, is a growing industry, and some months ago it was reported that about one hundred thousand such wheels were then in use in the United States. The number has since been materially increased.

Up to a comparatively recent period chilled wheels were used almost exclusively under both freight and passenger cars, and progressive changes consisted chiefly in improvements in patterns, sizes, selection of raw material, or details of methods of manufacture. The bulk of the car service of the United States has always been, and is now (1888), performed by wheels of this class, American practice differing materially from the course usually pursued by European railways. One leading cause of the preference for chilled wheels is the fact that their first cost is materially lower than that of any other class of car wheels, and another is the great experience gained in their manufacture and the variety of improvements which have been introduced from time to time. The growing demand for steel-tired wheels arises chiefly from a belief that they are capable of performing a greater amount of service, and are the safest under passenger cars run at high rates of speed. Questions have been raised in regard to relative economy, the contention on behalf of steel-tired wheels being to the effect that the extra amount of service they are usually capable of performing, and consequent diminution of the number of changes of wheels, compensates for the difference in first cost. This theory has been ably advocated on the one hand, and forcibly opposed on the other, by some of the manufacturers of chilled wheels and railway mechanics or managers.

CHILLED WHEELS.

An address delivered by Mr. Lobdell, of the Lobdell Car Wheel Company, before the New England Railroad Club, in February, 1888, embraced the following reference to leading features of chilled wheels:—

"When certain kinds of gray cast iron are melted and poured against a metallic mould, that portion of the iron next to the mould becomes hard, white crystalline, and brittle, while the interior portion remains gray and more or less tough and fibrous. This conversion of the part of the iron that strikes the metallic mould into the hard, white variety is called 'chilling,' and it is upon this principle that the manufacture of chilled car wheels depends. Metallurgists tell us that when most cast irons are melted and cooled suddenly the carbon in the iron is all retained in the combined form, but that if the cooling is effected slowly it separates partly as free carbon or graphite, and the chief chemical difference between the chilled iron and the soft iron of the same wheel or other article cast in a metallic mould is in the carbon, that of the chilled portion containing it in the combined state, whereas the soft or gray portion, while also containing some in the combined form, has more or less of it separated in the shape of graphite. All irons do not possess this property of chilling. It is possible to have such an excess of graphite carbon and silicon in the iron that, unless its chemical composition is materially changed in melting, it will not chill at all when run against a metallic mould. Other ingredients, such as manganese, phosphorus, and sulphur, have more or less influence on the chilling properties of iron and upon its strength. Many kinds of iron that possess good chilling properties are not strong—have not that degree of tenacity necessary to stand the sudden shocks or blows to which railroad wheels are subject, nor sufficient elasticity to stand the expansion of the rim by the heating of the same by the application of the brake, which often occasions the cracking of the brackets."

It is obvious that in a process based on such principles the qualities of the product depend largely upon the nature of the raw materials or mixtures of iron used, and the degree of care and skill exercised in the various stages of manufacture. The highest degree of excellence reached under favorable circumstances represents wheels that have fully met or exceeded all reasonable expectations, and the records of the performances of the wheels made by reputable manufacturers are usually creditable; but unsatisfactory results have been reported in cases where wheels were furnished at a price too low to afford compensation for the necessary amount of skill, care, and labor.

There are records of chilled wheels which ran considerably more than 100,000 miles, and in many cases their service has exceeded 50,000 miles, but their average performance is rated by some authorities at from 40,000 to 60,000 miles.

There is a considerable diversity in the depth of the chill of wheels made at various times and places and by different manufacturers, the general range being from ½ through the intermediate fractions of ¾ of an inch. The diameter of the wheels is usually 33 inches, and the weight of wheels of this size has varied from a little less than 500 pounds to more than 600 pounds.

The processes of manufacture differ considerably in some of the details in different establishments, special care being devoted at some places to annealing; at others extra efforts are made to secure a perfectly cylindrical shape; and one of the methods involves the use of steel scrap in the mixtures of iron. The productive capacity of the numerous works varies from about forty or fifty to several hundred wheels daily. Wherever the business is pursued successfully the labors involved represent one of the highest branches of the art of casting iron, on account of the complexities involved in the selection of irons, in chilling, and in producing wheels of desirable forms.

All wheels are presumably subjected to severe tests, either by the manufacturers or railway companies, or both, before they are put into service. The following remarks in regard to the tests of railway companies were made by Mr. Webber at a meeting of the New England Railroad Club, held on February 8th, 1888:—

"The Pennsylvania specifications as to the design, inspection, and manner of testing wheels are very similar to those of the New York, Lake Erie and Western; Chicago, Milwaukee and St. Paul; Chicago, Burlington and Quincy, and other western roads. The essential points in all of these specifications are: First, that the wheels shall be truly cylindrical; second, that the body of the wheel shall be smooth and free from shrinkage, slag or blow holes, the tread of the wheel from deep and irregular wrinkles, and free from sand or slag. Wheels broken must show clean gray iron, free from holes containing dirt or slag more than one-fourth inch diameter, or clusters of such holes, and the depth of white iron or chilled iron must not vary more than one-fourth inch from the standard depth round the tread of the wheel.

The drop test required to break out a piece of the iron varies from 140 pounds dropping 12 feet to 100 pounds dropping 7 feet, a corresponding increase in the number of blows being required. The essential point in this drop test is that any initial or shrinkage strain which may be in the wheel when cast will be detected by the force of these blows, and it is fair to assume that if one or two wheels out of 100 cast from the same heat and at the same time stand this test, the remaining ones would also stand it.

If the wheel is not truly cylindrical the brake pressure will be greater at one point of the circumference than at another, resulting almost certainly in the skidding or slipping of the wheel upon the rail, thereby producing a flat place upon the tread of the wheel, which is, of course, a source of great danger thereafter.

The Chicago, Burlington and Quincy claim to be almost entirely free from the breakage of wheels, and state that since the adoption of a system of car-wheel inspection and testing, as above, their mileage has increased very materially. About two years ago their mileage from wheels removed from their passenger equipment was only about 25,000 miles, and as a result of the above inspection and tests they have increased their mileage within the past year to an average of 43,000 miles. The Chicago, Milwaukee and St. Paul in 1887, up to the 1st of October, claim to have obtained an average of 60,000 miles for all wheels scrapped."

STEEL-TIRED CAR WHEELS.

Various styles of steel-tired wheels have been introduced on some of the railroads of the United States. One of the earliest was the paper car wheel, of which the Chicago Journal says:—

"When Richard N. Allen made his first set of paper car wheels in 1869 he was laughed at, and it was with difficulty that he got the use of a wood car for six months to test his invention. The Pullman Palace Car Company gave him his first order for a hundred wheels in 1871, and a few years later the Allen Paper Car Wheel Company made 17,000 such wheels in one year. One of the first sets of wheels experimented with under a sleeper is now on exhibition in Hudson, N. Y. It has a record of 300,000 miles' travel. Only the body of the wheel is of paper. The material is a calendered rye-straw 'board' or thick paper, made at Morris, Ill. This is sent to the works in circular sheets of 22 to 40 inches in diameter. Two men, standing by piles of these, rapidly brush over each sheet an even coat of flour paste, until there are a dozen of them, which make a layer. The layers are subjected to a hydraulic press, with a pressure of 500 tons. After various other manipulations several of these twelve-sheet layers are pasted together, until there are formed circular blocks containing 120 to 160 sheets each, compressed to 5½ or 4½ inches' thickness, just the size to fit the inner circle of the tire."

A report made to the Master Car-Builders' Association, in 1882, says:—

"In making a comparison of the value of wheels of different kinds, it seems to your committee that the first and most important item to be considered is safety. The construction of the Allen paper wheel is of such a nature that the body of the wheel, being paper, is a non-conductor, consequently the blow upon the rail does not reach the axle or centre of the wheel, thereby obviating to a great extent, if not entirely, the crystallization of the axle and increasing its safety and lessening the liability of the breaking of the wheels.

So far as we can ascertain, and from the limited experience we have had, the English wrought-iron centre wheel is a safe wheel—perhaps as safe as any in use, so far as its liability to break is concerned—but it does not obviate the concussions, which tend to crystallize the axle, as the paper wheel does.

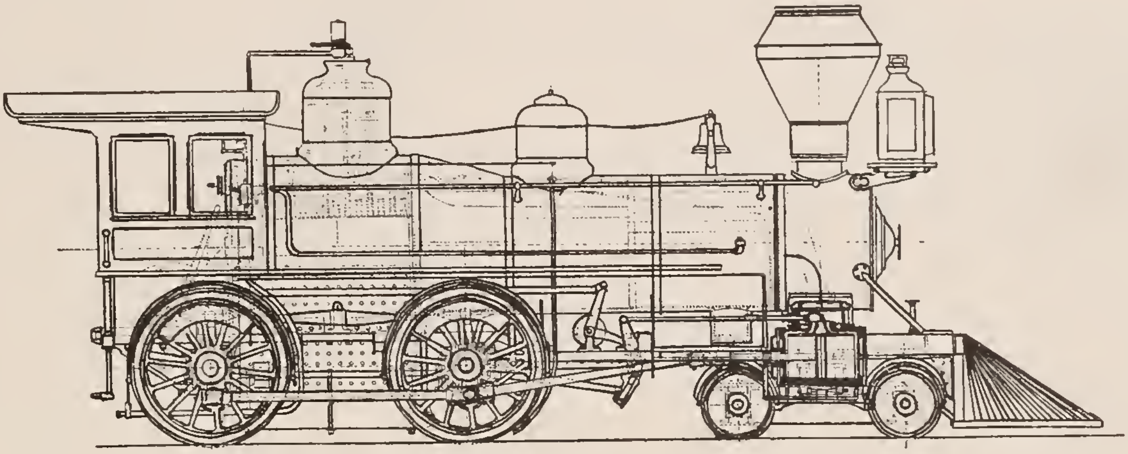
There are also other steel-tired wheels that commend themselves to the attention of railroad officers. The Paige wheel, with a wrought-iron plate centre; the Cooper wheel, with a cast-iron centre and which has a piece of vulcanized rubber under the tire, and the old, perhaps the first steel-tired wheel used to any extent in this country, is made by the Washburn Car Wheel Company, of Hartford, Conn. This wheel has been largely used by the Boston and Albany Railroad Company since 1870, and most of the passenger cars and many of the engine and tender trucks are equipped with those wheels. Since that time there has never been an accident caused by one of these wheels."

After that report was presented various other steel-tired wheels were invented or manufactured. The list of makers of steel-tired and steel wheels in 1887 included the following: Allen Paper Car Wheel Company, Pullman, Illinois; Allen Paper Car Wheel Company, Hudson, New York; Atwood Hemp Car Wheel Company, New York city; H. M. Boies, Scranton, Pennsylvania; Chester Steel Castings Company, Philadelphia; Fowler Steel Car Wheel Company, Chicago, Illinois; Miltimore Elastic Steel Wheel Company, Arlington, Vermont; Minton Steel Car Wheel Company, Chicago, Illinois; Paige Car Wheel Company, Cleveland, Ohio; Peckham Paper Car Wheel Company, Syracuse, New York; W. W. Snow, Ramapo, New York; Thomas Steel-Tired Wheel Company, Jersey City, New Jersey; Washburn Cast Steel Car Wheel Company, Raritan, New Jersey.

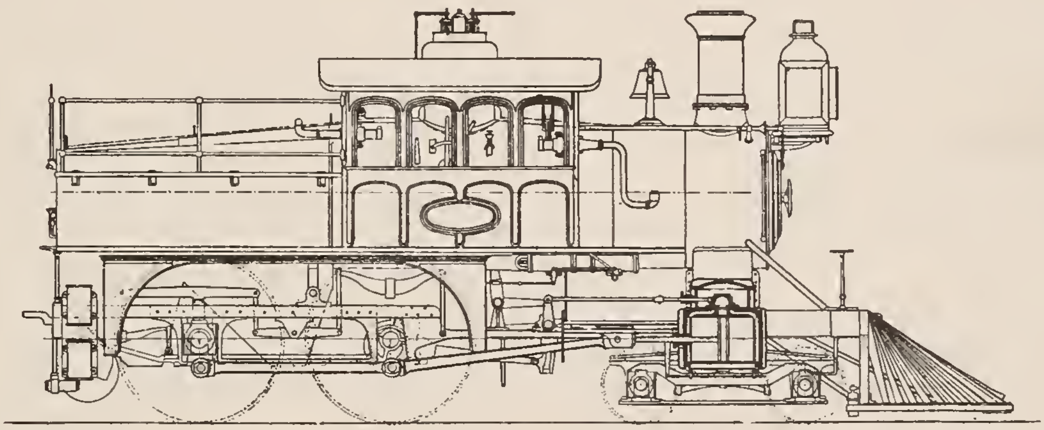
The tendency towards a substitution of steel-tired wheels for chilled wheels under fast passenger trains was presumably accelerated by the extensive and successful use of the Allen paper wheels under Pullman cars. In a few cases they have run more than 500,000 miles, and the manufacturers guarantee a minimum of 260,000 miles. Good records of steel-tired wheels under fast passenger trains in Europe also helped to direct attention in this country to that class of wheels after long runs of passenger trains at high rates of speed commenced. It was regarded by some experts as a debateable question, however, at the close of 1887, whether, if economy and all other questions involved are duly considered, the best styles of chilled wheels could not be advantageously used in ordinary passenger service, and the use of chilled wheels under freight cars continued to be nearly universal, except in connection with cars that rendered peculiar service, such as "palace" stock cars, &c. There is also, presumably, a notable difference in the respective merits of the steel-tired wheels made by different manufacturers.

CAR AXLES.

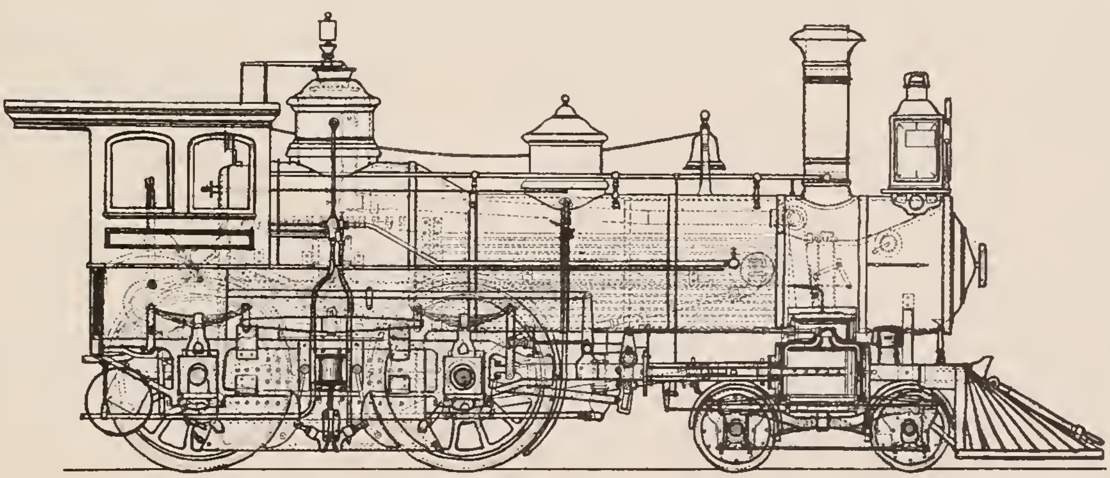
The manufacture of car axles forms an important industry, usually but not uniformly conducted in establishments which neither make car wheels nor cars. In service the wheel and axle are inseparable, being even more closely united in railway cars than in other vehicles, as they revolve together, instead of the wheel turning round the axle. Notwithstanding the ingenuity displayed by a number of inventors in attempts to ob-



Baldwin "American" Passenger Locomotive.



High Speed Wootten Locomotive.



Class A, New York Central Passenger Locomotive.

viate the objections to loose wheels, the steam railway practice of the country, with a very few minor exceptions, has always been substantially uniform in reference to this important subject, wheels being pressed upon axles by powerful hydraulic pressure, and each pair of wheels and the axle to which they are fastened being incapable of independent movements.

A list of the car axle manufacturers in the United States and Canada in June, 1887, contains the names of 71 makers, many of whom combined the industry with auxiliary pursuits.

The Chicago Railway Exposition of 1883 offered premiums for best steel axle (Master Car-Builders' Standard), best iron axle (Master Car-Builders' Standard), best hollow axle.

Puzzling questions have arisen in the progress of development in regard to the best methods of manufacture, including the shape and distribution of the metal used. Formerly axles were almost universally made of iron, but since the cost of steel was reduced a considerable percentage of the axles used under passenger cars have been made of steel. One of the leading distinctions between iron axles is based on differences between hammered iron and rolled iron. As broken axles are one of the things most greatly to be dreaded in train movements, much attention has been advantageously given to the causes of such disasters, and numerous advances have been made towards an increase of the guarantees of safety.

All important American railway companies have usually taken great pains to secure reliable axles for passenger cars. A notable illustration of this spirit is furnished by statements in a work on the Pennsylvania Railroad, published by its passenger department in 1875. In describing details of the passenger cars then used by that company it says: "In the highly important part (the axles) the effort for safety may be said to reach its climax. The journals are 7 inches long and 3¼ inches in diameter. This proportion of the axle renders it nearly impossible to break inside the wheel, and makes the journal the weakest part of the axle. The breaking of a journal is of little consequence, as the arrangement of the safety beams of the trucks is so thoroughly secure that after the journal has broken it will hold the wheel in its place for a distance of at least 20 miles, giving ample time to stop the train. Although the form of the axles is probably as perfect as any that has ever been produced, yet the greater claim to excellence lies in the quality of the metal used in their construction. They are made from soft crucible steel out of Swedish charcoal iron; are carefully turned to the proper size throughout, and before accepting them from the maker are subject to the following test: From every lot of fifty axles one is taken at random, and tested under a drop weighing 1,840 pounds. The axle is placed upon supports three feet apart, and struck in the centre. If the axle bears 5 blows of 25 feet each without breaking the lot is accepted. As an illustration of the quality of the steel used, a fact may be mentioned. On the 15th of November, 1867, one of these axles was broken only after 14 blows, of which 3 were at 35 feet, 1 at 36 feet, 2 at 38 feet, 7 at 30 feet, and the last at 40 feet, the axle being turned over at each blow. . . . As soon as an axle is found to have been under a passenger car 18 months it is ordered into the freight service, although it may be as good as new."

MASTER CAR-BUILDERS' STANDARD AXLE.

The Master Car-Builders' Association, at the annual convention held in Boston in 1873, recommended a standard of form and dimensions for car axles, which was modified by an increase of the diameter in the middle from 3⅞ inches to 4⅛ inches in 1874, and adopted. Other dimensions include the following: Length between hubs, 4 feet ½ inch; inside of collars, 6 feet 10 inches; from centre to centre of journals, 6 feet 3 inches; total length over all, 6 feet 11¼ inches; gauge of track, 4 feet 8½ inches.

The action of the master car builders in establishing a standard axle had an important influence in promoting uniformity, as this standard has since been maintained, but the desirability of a change of some of its details, in axles intended for use under freight cars carrying 60,000 pounds of freight, has attracted much attention, and efforts have been made to promote uniformity in regard to the axles used under such cars.

A report presented at the convention of the Master Car-Builders' Association, held in 1883, on the most economical carrying capacity for freight cars, which was based on replies to seven questions asked in circulars, contains the following statements:—

"*Second Question.* All the replies agree that 40,000 pounds of load, not including the car, is all that can safely be put upon the present master car-builders' standard axles and our present construction of freight-car equipment.

Third Question. Two are of the opinion that journals 3¾×7 inches are large enough for 5,000 pounds of load, not including the car. Six say that they consider 5,000 pounds enough for master car-builders' standard axles, and for carrying heavier loads than 5,000 pounds per journal one is not prepared to recommend the proper dimensions. The majority think that for loads of 7,000 pounds per wheel the dimensions of axles should be increased. Journals should be 4×7 inches. One says that for a load of 7,000 pounds per journal the journal should be 4¼×8 inches. Two recommend these dimensions. One of the persons replying says that he has observed that journals larger than 7 inches are more liable to break off at the shoulder.

Fourth Question. Several instances could be cited where journals have broken under the load, but in nearly every case the load has been 5,000 pounds or more on a journal only 3×5¾ inches.

Fifth Question. If any change should be made, two would favor the journals to be 4×8 inches. One would favor an increase, but he does not say how much. Two think that for a 40,000-pound load the present master car-builders' standard axle is sufficient, the wheel diameter being 33 inches.

Sixth Question. One does not think it policy to make axles larger than are required for safety, that being the only practical consideration. The majority are of opinion that a large factor of safety is economical, inasmuch as it is safe. Cases are cited where the breaking of an axle has caused damage amounting to several thousand dollars.

Seventh Question. One says that his road has had no broken axles this winter. One has had but few broken axles under freight equipment the past winter. Those that have broken have generally been small in journal and wheel fit. One has had but one master car-builders' standard axle break, and that was not properly welded. . . .

It is the opinion of your committee that the dimensions of the journals and wheel seats of master car-builders' standard axles are sufficiently large for loads of 5,000 pounds. They think that the middle of the axle should be increased to not less than 4 inches diameter when 33-inch wheels are used."

JOURNAL BEARING, JOURNAL BOX, AND PEDESTAL.

The fact that the wheels of steam cars revolve with the axles, instead of round the axles, as in ordinary vehicles, changes the point at which lubrication is necessary. It is on the part of the axle called the journal, which is next to the extreme outer end, consisting of a narrow portion called the axle collar. As these journals must bear all the burden of the weight of the car bodies and their contents that falls upon the axle, and yet revolve when the cars are in motion, it is vitally important that journal friction should be reduced. Complicated contrivances have been devised to promote this end. They embrace journal boxes or "brasses," placed immediately above the journal, and beneath a journal-bearing key or wedge, which are enclosed in a journal box, the lower portion of which is filled with waste kept saturated with lubricating material. Serious defects or derangements of this apparatus produce the effect, with which many travelers are familiar, of "hot boxes," necessitating the stoppage of trains until the defect is remedied. The master car builders have established standards relating to journal bearings, journal boxes, and a pedestal used in holding the journal box in its appropriate place. It is alleged that some of the practical workings of the journal boxes commonly used in the United States are inferior to those of corresponding devices in European countries, and that a great unnecessary waste of oil occurs here. In view of the notable superiority of nearly all other portions of the devices used beneath American cars, and the large amount of native inventive talent, it is remarkable that there should be such a defect.

DETAILS OF CAR TRUCKS.

A FUNDAMENTAL feature of all American cars is their trucks. The details include many parts, some of the most important of which are wheels, axles, journal-boxes, and journal-bearings.

These things are necessary to all successful car movements, and the great utility and importance of the car truck arises from the fact that it combines them with a large number of auxiliary appliances under such conditions that the aggregate combination forms, in itself, in a mechanical sense, a car. It might almost be said that the trucks are the cars, and what is placed above them is car bodies of many varieties. There are 4-wheeled trucks and 6-wheeled trucks, the latter being used chiefly under passenger cars, and generally only under exceptionally expensive specimens of them, such as Pullman cars. A large majority of the cars of this country are 8-wheeled cars, and these wheels and other necessary appliances are combined in two sets of 4-wheeled trucks, each of which helps to support the car body, and to carry it as a dead weight. A leading object of this arrangement is to support one long car body, with two short cars (or trucks), so as to enable long car bodies to be conveniently moved round sharp curves. Various other purposes are served, and it is by improvements of details of trucks that the promotion of a large proportion of all ends identified with the safety, economy, and comfort of car movements is sought.

An immense amount of mechanical genius has been devoted to such improvements, and changes of varying significance are constantly progressing. The peculiar conditions under which many American railroads were constructed and operated required the adoption of methods differing materially from European devices. It was necessary that passengers should ride in safety and comfort over roads abounding in sharp curves, and often in an imperfect condition, and that freight cars should carry exceptionally heavy loads. The invention and improvement of the car truck and its details form leading causes of the remarkable degree of success which has attended efforts to accomplish these objects.

Radical defects in trucks are always dangerous, and frequently attended with damaging or fatal results. In lengthy lists of causes of serious accidents, broken wheels, broken axles, and broken trucks represent a considerable percentage, which would be much larger if a vast amount of systematic carefulness was not constantly exercised. If precautions were grossly neglected no train could ever be 'n at high speed with a reasonable prospect that it would safely reach its destination.

TRUCK SPRINGS.

A number of springs of many sizes and patterns are used in car construction for the accomplishment of various purposes. One set are applied to different parts of the car body, and another set form part of the trucks. The truck springs are of great importance in promoting the comfort of passengers, and in diminishing the difficulties involved in the movement of freight. There are few classes of improvements in land vehicles in which more useful progress has been made than in those which relate to an increase in the quantity and quality of springs, and they are even more useful and indispensable in cars than in the numerous other vehicles to which they have been extensively applied.

Leading varieties of truck springs are elliptic and spiral, the former being used under passenger cars, generally in conjunction with the latter, while most freight-car trucks are supplied only with spiral springs. Journal springs are also necessary. Of these a report presented to the Master Car-Builders' Association in 1871 said: "The vital point to be secured in a journal spring is a direct up-and-down motion, with little or no side or lateral motion, and on passenger cars the journal spring should not be placed directly over the journal, but on a yoke or equalizing bar to secure the best results as to lift of spring and ease of motion."

In the earliest railway operations in this country leather or thorough-brace springs were used under passenger cars, but they were soon supplanted with imported elliptic springs, which were not arranged in a manner that rendered acceptable service, and they were far inferior to the better classes of elliptic springs subsequently manufactured here. The application of spiral springs commenced at a comparatively early date, and during a considerable period rubber springs were extensively used under passenger cars. Truck springs include the following varieties: Half elliptic spring, triple elliptic spring for passenger service, elliptic spring, double elliptic spring for freight service, half elliptic bolster spring for freight service, triple acme elliptic spring for passenger service, double or duplicate acme elliptic spring for freight service, concave elliptic spring. Elliptic springs are designated as duplicates, triplicates, quadruples, quintuples, and sextuples, according to the number of single springs grouped together. Of spiral springs there are numerous varieties and patterns, and a number of these are also frequently grouped. The list includes the following: Square-bar single-coil spring, keg-shaped spiral spring, spool-shaped spiral spring, volute spring, oval-bar double-coil buffer spring, round-bar triple-coil graduated spring, round-bar, double-coil buffer spring, round-bar single-coil spiral spring, round-bar double-coil spiral spring or nest spring, round-bar triple-coil spiral spring or nest spring, half-round double-coil spiral spring or nest spring, flat-bar or equal-bar triple-coil spiral spring or nest spring, Hibbard or flat-bar quadruple-coil nest spring, edge-rolled spiral spring, square-bar triple-coil nest spring, Dinsmore spiral spring. Two-group spiral springs include the following: Single-coil equalizer spring, double-coil bolster spring, double-coil equalizer spring, triple-coil equalizer spring, triple-coil flat-bar bolster spring, edge-rolled bolster spring. Three-group spiral springs include the round-bar bolster spring, the edge-rolled bolster spring, and the double-coil flat-bar bolster spring. Four-group spiral springs include the double-coil round-bar bolster spring and double-coil flat-bar bolster spring. Groups, ranging in number, respectively, from five to eleven, of bolster springs and graduated springs, embrace the following varieties: Graduated two-group bolster spring, triple-coil graduated equalizer spring, graduated three-group bolster spring, graduated five-group bolster spring, double-coil graduated bolster spring, double-coil graduated equalizer spring, triple-coil graduated bolster spring, three-group graduated bolster spring, and a two-group double-coil bolster spring, with inside spring case.

With the increase in the weight and capacity of freight cars a necessity was developed for an increase in the capacity of springs, which provision was promptly made by American manufacturers, who have displayed great skill in this as in other important auxiliary railway industries.

NAMES OF PARTS OF CAR TRUCKS.

It was scarcely to be expected, amid the multiplicity of inventions, that all car trucks should be of identical patterns, but the advantages of modifications introduced from time to time are usually quickly recognized, and approaches to approximate uniformity are thus hastened. A few years ago the diamond type of truck had become almost the universal standard for freight cars, although there were a number of varieties of this type. A list of its parts include the following: Wheel, axle, journal-box, journal-box cover, pedestal tie-bar, arch-bar, inverted arch-bar, auxiliary arch-bar, transom, transom-casting, truck-bolster, truck-bolster truss-rod, truck-bolster truss-block, truck-bolster truss rod bearing, truck-bolster truss rod washer, truck-bolster chafing-plate, bolster guide-bars, bolster-guide block, spring-plank, spring-plank bearing, swing-hangers, upper swing-hanger pivot, lower swing-hanger pivot, swing-hanger pivot, bearing-truck side-bearing, truck-centre plate, centre-plate block, bolster-spring seat, bolster-spring cap, bolster-spring brake-block, brake-head, brake-beam, brake eye-bolt, brake-hanger, brake-hanger carrier, brake safety-chain, brake safety-chain eye-bolt, brake-lever fulcrum, brake-lever guide, brake-lever sheave, brake-shoe, body centre-plate, journal-box bolts, column-bolt.

In addition to parts named above, excluding a few which are special to freight-car trucks, passenger-car trucks have a number of other parts, extra care being taken in their construction, and special efforts made to increase the power and effectiveness of the springs used, and to prevent jolting which would be annoying to passengers. A list of the names of the parts of passenger car trucks, including those special to 6-wheeled trucks, embraces the following: Wheel, axle, journal box, journal-box cover, pedestal, pedestal tie-bar, pedestal stay-rod, pedestal-brace, pedestal-brace tie-bar, wheel-piece, outside wheel-piece plate, inside wheel-piece plate, wheel-piece truss-rod, arch-bar, inverted arch-bar, auxiliary arch-bar, end piece of truck frame, transom, middle transom for 6-wheeled truck, outside transom for 6-wheeled truck, transom tie-bar, transom truss-rod, transom truss-block, transom truss-rod washer, transom chafing-plate, transom casting, transom pillar, truck-bolster, truck-bolster chafing plate, lateral-motion spring, lateral-motion spring-pin, spring-beam, spring-plank, spring-plank bearing, spring-plank safety strap, swing-hangers, upper swing-hanger pivot, lever swing-hanger pivot, swing-hanger pivot bearing, swing-hanger friction block, safety-beam, middle safety-beam, safety-beam block, axle safety-bearing, axle safety-strap, axle safety-bearing thimbles, safety-beam tie-rod, safety-beam iron, truck side-bearing, side-bearing bridge, truck centre-plate, centre-plate block, centre-bearing beam, centre-bearing arch-bar, centre-bearing inverted arch-bar, check-chain truck, check-chain hook, truck check-chain eye, equalizing-bar, equalizing-bar spring-cap, equalizing-bar spring-seat, bolster spring-seat, bolster spring-cap, spring-block, jaw-bit, journal spring, equalizing-bar spring, bolster-spring, truck-frame knee-iron, brake-block, brake-head, brake beam, brake eye-bolt, brake-hanger, brake-hanger carrier, brake safety-chain, brake safety-chain eye-bolt, brake safety-strap, release-spring, brake-lever, brake-lever fulcrum, brake-lever guide, brake-lever stop, brake-lever sheave, lower brake-rod, brake-shoe, journal-box guides, pedestal-horns, pedestal jaw, spring-hanger, spring-saddle, king-bolt, centre-pin.

THE DEVELOPMENT OF THE TRUCK.

An interesting speech was delivered by W. T. Hildrup, of the Harrisburg Car Manufacturing Company, at the annual convention of the Master Car-Builders' Association, held in 1883, during a discussion of standard freight and passenger-car trucks, in the course of which he said: "We appear to have no standard truck, either for freight or passenger cars, any more than we have had any time for the last forty years. Standards are made by the different railroads according to their interests as they appear to them, their convenience, and what may have been done by those preceding them. I remember a standard of forty years ago—five sticks of timber with four sleeve boxes, with flanges to attach them to the timbers. It was a very simple beginning, and it was thought by many to be a very substantial, meritorious truck. We would consider that to-day not admissible under any circumstances. My first knowledge of an iron truck was two parallel bars on each side connecting the boxes rigidly, and a half-elliptic spring reaching from one to the other, sliding in a pocket. The pocket was considered to be such an advantage that it was patented, as well as the truck. Men of my age in the business will remember many of the experiments, the efforts, and the progress. I remember the passenger-car trucks when the wheel pieces were four by eight inches, and considered sufficient for a load. Now they have progressed to a very firm structure. Take the diamond truck. There are those who believe that it is the best attainable under their system of railroading. There are modifications of that in various ways used and accepted as the best attainable under the circumstances, and there are a very great variety of models and designs in use. Who shall say to-day there is a standard truck that we can all agree on, and accept as being worthy of the times? Were any of our standards of earlier days anything more than stepping stones to that which we desire, some very great improvement over our present usages and customs? . . . We have yet to determine on a truck which shall be satisfactory to all our judgments and all our experiences. We have made great advances. We have been educated by our experience. Our experience is not always the sole controlling element with us. There are conditions which were fixed years ago, modified here and there as occasion will admit. But we have fixed a standard of axle. It is certainly a very great advance. But we see in the discussions and reports of to-day that that axle is questioned, is doubted. It is doubted whether it is of sufficient strength. It is doubted whether the journal is large enough for the best results. Now, it is within the experience of most of the gentlemen here that only a few years ago the acme of axles was considered that which had the smallest possible journal; that that was the point to attain for least friction, for least obstruction in the journal. I do not know to-day any individual whose judgment can be respected who maintains that position. I know that twenty-five years ago it was universally accepted, or almost universally accepted, as being the proper theory. That illustrates how we advance from one thing to another."

INCREASE OF RAILWAY MILEAGE FROM 1880 TO 1887, INCLUSIVE.

UNOFFICIAL methods of ascertaining the new mileage constructed in and since 1880 can scarcely be expected to be as accurate as those furnished by the reports of all companies to the Census Bureau. Estimates have been published, from year to year, which are presumably approximately correct, and from them the following table has been compiled:—

ESTIMATED AMOUNT OF NEW CONSTRUCTION IN EACH STATE AND TERRITORY IN EACH OF THE YEARS NAMED.

States and Territories:—	1880. Miles.	1881. Miles.	1882. Miles.	1883. Miles.	1884. Miles.	1885. Miles.	1886. Miles.	1887 Miles.
Maine	3.00	23.25	29.25	43.12	43.46	....	14.00	31 00
New Hampshire	....	6.81	17.50	3.00	....	....	6.00	23.00
Vermont	36.00	2.00	2 00	12.00	5.08	3.00	....	....
Massachusetts	42.50	45.94	8.30	15.44	13 88	12.54	20.66	55.00
Rhode Island	....	1.25	....	....	....	....	...	....
Connecticut	33.75	36.85	2.70	....	11.54	....	....	....
New England States	115.25	114.10	59.75	73.56	73.72	15.54	40.60	109.00

	1880. Miles.	1881. Miles.	1882. Miles.	1883. Miles.	1884. Miles.	1885. Miles.	1886. Miles.	1887. Miles.
New York	47.50	269.61	705.05	357.86	10.91	57.06	96.27	97.00
New Jersey	54.50	89.29	89.41	12.22	27.13	14.12	37.29	15.00
Pennsylvania	159.50	165.37	526.29	377.74	315.68	231.43	204.69	125.00
Delaware	....	....	6.78	2.96	20.98	3.19	18.45	....
Maryland	40.75	25.00	33.46	21.50	12.90	51.45	35.98	18.00
West Virginia	10.00	15.00	107.39	133.80	81.75	20.00	107.00	53.00
Middle States	312.25	564.27	1,468.38	906.08	468.45	377.35	499.68	308.00
Virginia	207.90	327.19	221.85	102.82	118.09	18.51	37.00	64.00
North Carolina	30.50	158.75	136.75	30.75	174.12	57.50	173.90	184.00
South Carolina	31.00	52.00	38.25	40.75	25.75	100.00	126 50	104.00
Georgia	45.00	101.50	334.40	54.80	94.00	133.75	274.25	231.00
Florida	37.50	145.00	271.43	192.48	182.62	272.34	314.99	193.00
Alabama	22.00	14.00	50.00	177.10	96.26	20.40	54.50	515.00
Mississippi	....	55.50	120.50	313.35	228 21	82.49	191.09	99.00
Louisiana	124.00	262.00	94.81	193.78	112.00	55.00	10.70	65.00
Tennessee	32.00	56.33	165.44	47.40	55.99	7.00	41.56	68.00
Kentucky	47.50	142.30	73.00	106.73	24.33	37.35	106.84	168.00
Southern States	576.50	1,314.57	1,506.43	1,259.66	1,111.37	784.34	1,331.33	1,691.00
Ohio	500.00	496.56	610.33	316 05	106.35	20 30	118.66	155.00
Michigan	255.00	345.48	327.72	457.88	130.29	98.56	367.17	700.00
Indiana	185 50	386.05	611.65	171.06	23.29	65.40	111.37	115.00
Illinois	321.75	409.20	442.89	191.71	40.90	83.97	370 92	328.00
Wisconsin	226.00	302.05	352.86	228.42	238.10	128 07	451.27	363 00
Central Northern States	1,488.25	1,939.34	2,345.45	1,365.12	538.99	402.30	1,419.39	1,661.00
Minnesota	133.50	186.76	596 74	171.08	256 03	140.88	492.09	196.00
Dakota Territory	724.00	413.00	400 10	410.97	163.60	118.50	821.48	760.00
Iowa	456.75	764.10	802.62	243.52	273.66	48.36	431.13	352.00
Nebraska	377.10	323.73	221.06	198.25	101.57	218.95	628.08	1,101.00
Kansas	363.50	208.56	211.33	144.17	159.21	260.37	1,678.04	2,070.00
Missouri	313.50	242.35	293.54	118.06	100.03	259 02	99.48	554.00
Indian Territory	....	6.00	65.00	3.00	....	....	72 17	499.00
Arkansas	60.75	143.50	499.50	245.08	33.50	41 08	49.50	153.00
Texas	653.00	1,669.40	1,080.54	98.60	90.00	190.50	607.90	1,055 00
Colorado	348.25	616.98	579.41	66.01	28.30	12.00	59.20	818.00
Wyoming Territory	....	64.00	48.71	....	....	....	160.89	133.00
Montana Territory	73.53	157.00	391.50	401.80	9.97	....	15.80	616.00
North-western and South-western States	3,502.85	4,795.38	4,990.05	2,100.54	1,345.87	1,289.66	5,122.76	8,307.00
Nevada	71.00	156.09	53.50	....	....	....	....	....
California	2.00	114.40	327.89	245.40	41.70	149.55	252.46	4.00
New Mexico	540.50	289.37	41.68	50.90	43.89	3.30	38.00	358.00
Idaho	....	69.00	216.30	282.96	39.98	5.00	13.50	54.00
Utah	116.25	35.00	185.32	61.80	4.00	4.00	....	6.00
Arizona Territory	198.00	148.30	216.18	152.60	5.00	....	83.00	70.00
Oregon	165 50	66.00	180.00	194.30	211.60	100.20	38.20	48.00
Washington Territory	62.00	183.50	....	125.50	89.20	....	161.50	108.00
Pacific States, &c	1,155.25	1,061.57	1,220.87	1,113.46	435.37	262.05	586 66	648.00
Recapitulation:—								
New England States	115.25	114.10	59.75	73.56	73.72	15.54	40.66	109.00
Middle States	312 25	564 27	1,468.38	906.08	468.45	377.25	499 68	308.00
Southern States	576.50	1,314.57	1,506.43	1,259.93	1,111.37	784.34	1,331.33	1,691.00
Central Northern States	1,488.25	1,939.34	2,345.45	1,365.12	538.93	402 30	1,419.39	1,661.00
North-western and South-western States, &c	3,502.85	4,795.38	4,990.05	2,100.54	1,345.87	1,289.66	5,122.76	8,307.00
Pacific States and Territories	1,155.25	1,061.57	1,220.87	1,113.46	435.37	262.05	586.66	648.00
Grand total	7,150.35	9,789.23	11,590.93	6,818.72	3,973.71	3,131.14	9,000.48	12,724.00

Revisions have led to changes in the totals given above, so as to make them correspond to the following figures: 1880, 6,876; 1881, 9,796; 1882, 11,568; 1883, 6,741; 1884, 3,825; 1885, 3,608; 1886, 9,000; 1887, 12,724. The aggregate additions to new mileage, from 1880 to 1887, inclusive, represented by these estimates are 64,138 miles, which amount, added to the census report of mileage existing at the end of 1879, which was 84,964, made the total length of railways in the United States, at the end of 1887, 149,102 miles.

CAUSES OF EXTENSIVE CONSTRUCTION.

The construction of 64,000 miles of railway in such a brief period is an extraordinary feat. Its accomplishment can only be explained by a variety of circumstances. One of the most important was the absence of the immense pressure imposed upon other nations by huge standing armies, great naval establishments, and burdensome public debts. Energies and resources spent elsewhere, and in other ages, in destructive wars, or preparations for them, were here devoted to the removal of natural obstacles to free intercourse, and the creation of cheap and convenient facilities for transportation. The rebound from the panic of 1873, the restoration of specie payments, and the export of immense quantities of agricultural products, helped to incite and render feasible many projects. Other favorable conditions were the ease with which charters and the privilege of procuring or condemning a right of way could be obtained; the rapidity with which new settlements were established, and a large immigration attracted to young states and territories; the reduction of public debts, and consequent necessity of shifting investments; the notable extent to which railway construction has become an established industry and a favorite speculative enterprise with a large number of adventurous promoters or projectors, contractors, and capitalists in the United States, and the absence of severe requirements relating to the issue of railway securities, and the physical characteristics of lines when they are first opened.

SYSTEMS OF CAPITALIZATION.

Of some of the new lines it may be said that they were built in haste to be improved at leisure, and that the face value of the various securities issued to represent their cost greatly exceeded the sums actually expended for construction. It has been alleged that in some instances the proportion was not far from three dollars of stock and bonds of different grades to one dollar of money spent, but such cases were exceptional, and probably less numerous than the instances in which it was impossible to earn interest on one-third of the real expenditure for new roads. In a few of the older states, and notably in Massachusetts, New York, and Pennsylvania, an increasing disposition was manifested to impose a check on fanciful railway capitalization, or to create safeguards against unnecessary or premature construction, but in most portions of the country there were few serious obstacles to the manufacture of all the new securities that could be marketed, and the building of all the lines that could presumably be rendered a source of profit to their projectors. There were, however, in a number of instances, notable improvements in matters relating to capitalization and methods of construction. In some quarters there was a tendency to return to the original method of providing the bulk of the sum required to build a new line from the sale of stock. In others the purchasers of first mortgage bonds received a much larger proportion of issues of stock and junior securities than had formerly been given to them. A number of the new lines were built chiefly as extensions of old systems, mainly with the proceeds of bonds endorsed by powerful companies, and much of the new construction was, at the time it was opened, in a decidedly better condition, in an engineering sense, and much more fully supplied with desirable appurtenances, than was formerly common.

SPECIAL FEATURES OF THE CONSTRUCTION OF DIFFERENT YEARS.

The average rate of increase during the eight years ending December 31st, 1887, was a little more than 8,000 miles. The rapidity with which many of the additions were made forms one of the most notable and important events in modern industrial and financial history. The variations in the amount of construction per annum are as strongly marked as in previous periods. The lowest new mileage in any one year is 3,131.14 in 1885, and the highest 12,724 in 1887. Before the commencement of the decade a furore for new construction commenced, which culminated in 1882. The lowest point of the receding wave was reached in 1885.

The first great impulse favoring new construction commenced before 1880, during which year work was actively progressing on several new transcontinental lines and many smaller roads. Nearly 80 per cent. of the new mileage of 1880 was located west of the Mississippi river, and the activity displayed was largely due, first, to the notable increase in its population, and, second, to the revival of a belief among projectors and capitalists that it might be made prudent, practicable, and profitable to build extensive lines in districts where there was not sufficient existing traffic to render such enterprises remunerative in the confident expectation that the country would speedily "grow up" to its railway facilities.

The furore for new construction, and the demand for new railway securities, continued to increase during 1880 and 1881 to such an extent that the Investors' Supplement of the Commercial and Financial Chronicle, published in October, 1881, contained an estimate of the miles of railroad to be laid from October, 1881, to December 31st, 1882, giving the names of the companies, which footed up 15,886 miles. Geographically this mileage was located as follows: Between the Atlantic coast and the Upper Mississippi river, and north of the Ohio and Potomac rivers, 4,791 miles; between the Atlantic coast and Mississippi river, and south of the Ohio and Potomac rivers, 2,352; between the Rocky mountains and Mississippi river, and north of the latitude of St. Louis, 4,063; between the Rocky mountains and Mississippi river, and south of the latitude of St. Louis, 4,140; west of the Rocky mountains, 540.

NEW CONSTRUCTION OF 1882.

Of the new construction actually completed in 1882, a review published in the New York World in January, 1883, said:—

"During 1882 there were constructed about 10,500 miles of railroad, with a possibility that more complete returns may increase the total to 11,000. The impetus given to railroad building in 1880 and 1881, resulting from a revival of business, and the consequent abundance of capital seeking investment, arrived at its full momentum in the year 1882. The increase in values represented by solid and permanent investments in railroad property during the period covered by those three years may be safely estimated at $1,250,000,000. In 1880 there were constructed 7,200 miles; in 1881, 9,500 miles, and in 1882, say, 11,000. This makes a total for the three years of about 27,700 miles, which, estimated at an average cost of $25,000 per mile, equals $692,500,000. Deducting this sum, leaves a balance of $557,500,000, which represents the improvements and betterments to the old lines.

Public interest in railroad construction during 1882 has centred largely in the completion of the new "Nickel-Plate" line extending from Buffalo to Chicago, a distance of 523 miles, which was commenced in 1881 and was completed about August, 1882. The New York, Lackawanna and Western, better known as the Buffalo extension of the Delaware, Lackawanna and Western, extending from Binghamton to Buffalo, 200 miles, and the Chicago and Atlantic, popularly known as the Erie's Chicago extension, extending from Marion, Ohio, to Chicago, 269 miles, were both completed during the year. Their chief value lies in the fact that they supply independent outlets to the points at which they terminate for the roads with which they are affiliated. On the New York, West Shore and Buffalo road, which parallels the New York Central from New York to Buffalo, much of the preliminary work has been done and about 100 miles of new track have been laid. The other lines in New York, Pennsylvania, and New Jersey have been actively extending and perfecting their lines into the coal and oil regions of those states—notably the Buffalo, Pittsburgh and Western, the Buffalo, New York and Philadelphia, the Rochester and Pittsburgh, the Pennsylvania, the New York, Susquehanna and Western, and other roads of minor importance.

In the south the development, as compared with former years, has been decidedly marked. The Louisville and Nashville has completed its branch to the Tennessee line, there to connect with the Knoxville and Augusta line, controlled by the Richmond and West Point Terminal Company. The East Tennessee, Virginia and Georgia road has completed its Georgia division, giving it an unbroken line from Rome to Brunswick. The Pensacola and Atlantic has completed its line from Pensacola to the Chattahoochie river, a distance of 160 miles. Much work has been done on the New Orleans and Northeastern, the New Orleans line of the Erlanger syndicate, also on the New Orleans and Mississippi Valley, not to speak of innumerable small lines and branches.

The south-western system of roads, consisting of the Missouri Pacific; Missouri, Kansas and Texas; St. Louis, Iron Mountain and Southern; International and Great Northern, and Texas Pacific roads, have been vigorously prosecuting the work of extending and perfecting their lines, the more important branches being the Omaha extension (in Nebraska) of the Missouri Pacific; the Crowley's Ridge branch (in Arkansas) of the St. Louis, Iron Mountain and Southern; the completion of the lines from Waco, Tex., to Taylor, and from Encinal to Laredo, where connection will be made with the Mexican, Oriental, Interoceanic and International line. In the same section we find the St. Louis and San Francisco completing its Fort Smith line; the Texas and St. Louis narrow gauge nearly completing its line from Texarkana to Cairo, which will give that company a line of over 730 miles in length, extending from Cairo to Galesville, Tex. The Fort Worth and Denver City was completed from Fort Worth to Wichita Falls, 113 miles, also the El Paso and Eagle Pass divisions of the Galveston, Harrisburg and San Antonio. The Atchison, Topeka and Santa Fe, in addition to several small branches, has completed its line in Arizona to the Mexican boundary line, and a connection with the Sonora Railroad, of Mexico, which that company owns.

The new transcontinental line to be formed by the Atlantic and Pacific and the Southern Pacific will probably be completed in 1883. On the former line the western section of the road has been extended to a point 445 miles west of Albuquerque, and the Southern Pacific has been extended east from Mojave, a distance of 80 miles. The eastern section of the Atlantic and Pacific has been extended west to Tulsa. These gaps, when completed, will form a line of road from San Francisco to St. Louis over the Southern Pacific, Atlantic and Pacific, and St. Louis and San Francisco roads.

Further north the Union Pacific has been building several branch lines and has been pushing the work on the Oregon Short line, which will meet at Baker City a line now being built south-east by the Oregon Railway and Navigation Company. The Denver and Rio Grande and the Denver and Rio Grande Western, an offshoot of the former, have nearly completed a line from Gunnison City to Salt Lake and Ogden, as well as a number of branches.

The Northern Pacific Railroad in the north-west has prosecuted its work with surprising vigor. The western end is now some miles east of Second Crossing, Montana, and the eastern end some miles west of Livingston, in the same territory. The intervening gap is rapidly being filled up, and it is expected that by the 1st of April it will be less than 200 miles. In addition to the main track constructed by this line in 1882, amounting to more than 600 miles, there have been built by the Oregon Transcontinental Company for that line about 250 miles of branch road.

The Chicago, Milwaukee and St. Paul is second on the list in the north-west, its total construction during the year amounting to about 470 miles, mainly in lines and branches projected last year. The Chicago and North-western follows closely with a few miles less than the St. Paul road. The latter's construction was in Iowa, Dakota, and Wisconsin, and was also in branch lines and extensions. The St. Paul, Minneapolis and Manitoba also showed considerable vigor during the year, having constructed north to the Minnesota boundary line, west towards Devil's Lake, and from St. Cloud to Hinckley. The aggregate amounted to 226 miles. The Chicago, St. Paul, Minneapolis and Manitoba has been no less active, and in various extensions has reached a total of more than 200 miles.

The Humeston and Shenandoah road, running through southern Iowa 113 miles, has been built by the Wabash and the Chicago, Burlington and Quincy as joint owners. The latter company also completed early in the year its Denver extension.

The Milwaukee and Lake Winnebago, or Milwaukee extension of the Wisconsin Central, 65 miles in length, was recently completed; also the Minnesota Central, a new road of about the same length.

In the central states of the Union the leading companies have been actively engaged in perfecting their systems by building extensions and feeders in every direction where the prospective traffic presented a suitable field. The more noticeable extensions have been on the Indiana, Bloomington and Western; Wheeling and Lake Erie; Grand Rapids and Indiana; Toledo, Cincinnati and St. Louis; Connotton Valley; Chicago and West Michigan; Louisville, Evansville and St. Louis, and Louisville, Albany and Chicago railroads."

NEW CONSTRUCTION IN 1883–84–85.

During 1883 a reactionary feeling was being rapidly developed; the price of stocks declining, and the eagerness of investors to purchase bonds of railway companies diminishing. The mileage of the lines completed in that year in the various sections was reported to be as follows: New England states, 73.03; Middle states, 877.78; Southern states, 1,241.02; Western states and territories, 3,832.83; Pacific states and territories, 728.80. The companies that built lines more than one hundred miles in length, in a single state or territory, included the following: New York, West Shore and Buffalo, 238.93 miles; Louisville, New Orleans and Texas, 143 miles in Mississippi and 100 miles in Louisiana; Michigan and Ohio, 121.50; Chicago and Northwestern, 138.77 in Dakota; Chicago, Milwaukee and St. Paul, 144.94 in Dakota; Burlington and Missouri River, 111.25 miles in Nebraska; Kansas City, Springfield and Memphis, 134.77 in Arkansas; Atlantic and Pacific, 119.60 miles in Arizona; Oregon Short Line, 282.96 miles in Idaho; Northern Pacific, 330 miles in Montana; Carson and Colorado, Third division, 100 miles in California; Southern Pacific, 122.51 miles in California; Palouse branch, 100 miles in Washington Territory.

In 1884 the distrust and depression which commenced in 1883 were intensified, and the amount of new construction greatly diminished, in comparison with former years. The reported new mileage in each group was as follows: New England states, 73.72; Middle states, 462.03; Southern states, 1,105.37; Western states and territories, 1,886; Pacific states and territories, 450.27; total, 3,977.39.

A contemporaneous account of the operations of the year says:—

"In 1884 receivers were appointed for 43 different companies, several of them of much importance, including the New York, West Shore and Buffalo; Wabash, St. Louis and Pacific; Philadelphia and Reading; Denver and Rio Grande; Allegheny Valley; Ohio Central; Texas and St. Louis; Western, Portland and Ogdensburg; Memphis and Little Rock; Wheeling and Lake Erie, and some others of less note. Not a few other companies are struggling with difficulty to keep their heads above water, and unless the times and the public temper improve there is likely to be a considerable addition to the list of receiverships during the coming year.

The construction record of 1884 has not been a remarkable one, although the total is even greater than could perhaps have been expected. About 4,000 miles of new main tracks have been laid on 166 different lines. This shows an average of only about 24 miles to each road, which indicates that most of the construction has been on extensions or branches. The principal lines which have been completed during the year are the following: The Oregon Short Line of the Union Pacific Railway Company to its terminus at Huntington, Oregon; the Oregon Railway and Navigation Company's main line to the same point, connecting with the first-named road, forming another route to the Pacific; the Louisville, New Orleans and Texas, completing a road from Memphis to New Orleans along the Mississippi river; the Wisconsin Central's line from Chippewa Falls, Wisconsin, to St. Paul, Minnesota; the Burlington, Cedar Rapids and Northern extension through Minnesota to Watertown, Dakota Territory; the extension of the Minneapolis and St. Louis to the same point; the completion of the Northern Pacific, Wisconsin division, to Ashland, Wisconsin; the New York, Philadelphia and Norfolk, which has been finished through Maryland to a point opposite Norfolk, Virginia. A number of other shorter lines of local importance have been finished. Among the roads in progress are the Baltimore and Ohio's line to New York; the Milwaukee, Lake Shore and Western extension to Ashland, Wisconsin, through Michigan; the Northern Pacific's main line over the Cascade mountains to Puget Sound, and the Oregon and California, and the California and Oregon roads, which are pushing towards each other to give an all-rail line between Portland and San Francisco. The very large number of railway enterprises commenced or projected during the year indicates that railway building will still continue in spite of business depression, and when good times return it will assume extraordinary activity."

In 1885 there was a further decline in the amount of new construction, and few signs of a revival of confidence until the latter portion of the year, when an adjustment of trunk-line difficulties, arrangements for the acquisition of the West Shore by the New York Central, and for a transfer of the control of the South Pennsylvania project to the Pennsylvania Company, together with other favorable influences, infused a new spirit in financial circles, and led to a large increase in the amount of new construction in 1886 and 1887.

The following table shows the construction in each year, the cost of all roads, including equipment, the capital stock, and funded debt on the mileage of all the companies reporting at the end of the fiscal year:—

Year.	New mileage.	Cost of roads and eqnipment.	Capital stock.	Funded debt.
1880..........	6,876	$4,653,609,297	$2,553,734,177	$2,392,017,820
1881..........	9,796	5,577,996,931	3,195,438,156	2,890,497,364
1882..........	11,568	5,930,409,624	3,456 078,196	3,184,415,201
1883..........	6,741	6,684,756,045	3,708,060,583	3,455,040,383
1884..........	3,825	6,924,554,444	3,762,618,686	3,669,115,772
1885..........	3,608	7,037,627,350	3,817,697,832	3,765,727,066
1886..........	9,000	7,254,995,223	3,999,508,508	3,882,966,330
1887..........	12,724	....	....	....

It will be seen that there was an immense increase in the cost of roads and equipment, and a corresponding increase in the volume of railway securities, from 1880 to 1884, while from

1884 to 1885 the increase was comparatively slight. The new construction of 1885 represented additions of one hundred miles or more to the length of lines in the following states: Pennsylvania, South Carolina, Georgia, Florida, Wisconsin, Minnesota, Dakota Territory, Nebraska, Kansas, Missouri, Texas, California, Oregon.

NEW CONSTRUCTION IN 1886–87.

The revival of active railway-building operations in 1886–87 led to comparatively small additions to mileage in the New England and Middle states, but to notable advances in other groups, the gains being exceptionally large in the North-western and South-western states.

One of the most important new lines opened in 1886 in the Middle states was the Baltimore and Ohio extension from Baltimore to Philadelphia. Of the new construction in South Atlantic states, prominent features were large additions to the railway mileage of Florida, and extensions of the Norfolk and Western, and Richmond and West Point Terminal systems. The largest amount of new construction on a single line in the Central Northern states in 1886 was probably on the Chicago, Burlington and Northern. The amount of new construction in that year in each of the states of Michigan and Illinois exceeded 300 miles, and in Wisconsin the reported amount exceeds 450 miles. The specially active railway building of 1886 was in the North-western and South-western states, and it consisted largely of lines intended to serve as extensions of the gigantic systems of those states.

Reports or estimates of the new construction of 1887 classify it geographically as follows: New England states, 109 miles; Middle states, 308; Southern states, 1,691; Central Northern states, 1,661; North-western and South-western states, 8,307; Pacific states, 648. The largest amount of new construction in any state east of the Mississippi was in Michigan. Alabama stands second on the list.

The following statement is published in the Government report of internal commerce of new construction completed in the north-west in 1887, viz.:—

Railroads.	Miles.
St. Paul, Minneapolis and Manitoba	845.00
Montana Central	97.00
Chicago, Milwaukee and St. Paul	371.00
Minneapolis, Sault St. Marie and Atlantic	357.00
Chicago and North-western	135.69
Duluth, South Shore and Atlantic	204 00
Fremont, Elkhorn and Missouri Valley	358.00
Chicago, St. Paul, Minneapolis and Omaha	34 05
Wisconsin Central	32 62
Northern Pacific	310.00
Illinois Central	387.00
St. Paul and Duluth	15.00
Chicago, St. Paul and Kansas City	305.60
Minneapolis and St. Louis	10.00
Minneapolis and Pacific	71.00
Total	3,533.96

The additions to large systems in the south-western group in 1887 have been estimated as follows: Atchison, Topeka and Santa Fe, 1,694; Missouri Pacific, 900; Chicago, Rock Island and Pacific, 825; Chicago, Burlington and Quincy, 702; Union Pacific and St. Joseph and Grand Island, 345; St. Louis and San Francisco, 325.

The fluctuations in amount of new construction per annum furnish an indication of the speculative temper of various eras, and the relative abundance or scarcity of money available for railway purposes. When dividends are passed or reduced, failures to pay interest on bonds frequent, foreclosure sales numerous, and rival lines are engaged in fierce competitive struggles, there is little to encourage capitalists to largely increase their investments in railway securities. When a period of gloomy distrust and depression is succeeded by a revival of prosperity, and railway credit is in a great measure restored, it becomes comparatively easy to obtain enormous sums for the construction of new lines, and excessive timidity is succeeded by eagerness to supply means for roads of many classes, including some which have little prospect of speedily yielding remunerative returns to investors.

Much of the new construction from 1880 to 1887 was in districts that had not previously been supplied with railway facilities. This is particularly true of many of the regions traversed in the specially active theatres of new construction lying west of the Mississippi. There was, however, a considerable amount of building of new competitive lines; and much of the new mileage competes for some classes of the traffic of roads completed before 1880. A large percentage of the new work in the older states consisted of the construction of short branches or extensions which increased facilities for local passenger or freight movements.

NEW CONSTRUCTION IN GROUPS EAST OF THE MISSISSIPPI.

GEOGRAPHICALLY the new construction from 1880 to 1887 was distributed, approximately, as follows: In New England, about 600 miles; in the Middle states, including New York, New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia, nearly 4,900 miles; in the Atlantic, Gulf, and Mississippi Valley states, including Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Kentucky, and Louisiana, about 9,500 miles; in the group of Central Northern states, including Ohio, Michigan, Indiana, Illinois, and Wisconsin, about 11,000 miles; in the group of North-western states, including Iowa, Minnesota, Nebraska, Dakota, Wyoming, and Montana, more than 14,000 miles; in the group of South-western states, including Missouri, Arkansas, Texas, Kansas, Colorado, and New Mexico, more than 18,500 miles; in the Pacific group, including Washington Territory, Oregon, California, Nevada, Arizona, and Utah, about 5,500 miles. More than 60 per cent. of the new mileage was in districts west of the Mississippi, and nearly half of this was in the states and territories belonging to the South-western group.

NEW CONSTRUCTION IN NEW ENGLAND

consisted chiefly of short lines intended to serve local interests, a leading object, in some instances, being an improvement of facilities for reaching popular resorts, or short branches or extensions of established railways. There was an addition to the New York and New England by which its system was extended to the Hudson river, and this is one of the few undertakings that exercised a considerable influence upon through movements. Some of the new mileage includes New England connections with Canadian roads. One of the longest of the new lines was the Central Massachusetts, 70.2 miles, leading from Cambridge to Ware. The Poughkeepsie bridge over the Hudson river was well advanced towards completion during 1887, and new railway connections with it in New England and New York may exercise an important influence on various classes of traffic, especially the coal trade.

NEW CONSTRUCTION IN THE MIDDLE STATES.

A number of the lines constructed in the Middle states were comparatively short, and intended chiefly to promote local interests, or to furnish improved methods for traveling to and from popular seaside, mountain, or interior resorts. Several roads were built mainly for the purpose of improving facilities for reaching various points in the Catskill mountains; a number of branches or short lines were constructed which are intended chiefly to facilitate movements to places on the Atlantic coast, in New Jersey and New York; and other short roads or branches were built chiefly to reach a number of popular resorts in New York, Pennsylvania, and Maryland. The increase of excursion-route business, and the occasional movement of large bodies of people from populous cities to adjacent resorts, especially during the summer season, furnished one of the minor incentives to construction.

A considerable amount of new mileage was constructed for the purpose of opening up connections with bituminous and anthracite coal fields and coke districts. The most important new road extending into the anthracite region was the Pennsylvania Schuylkill Valley, leading from Philadelphia to and through the Schuylkill region, constructed under the auspices of the Pennsylvania Railroad. Some of the new mileage of the decade is intended to improve facilities for transporting anthracite in eastern or north-eastern directions. One of the most important new bituminous coal roads was the Beech Creek and connections, by which the New York Central and Reading systems obtained an entrance into the Clearfield district. A number of other coal roads materially improved the facilities of the Pennsylvania system for reaching bituminous districts. The New York, Lake Erie and Western accomplished similar objects, materially increased its facilities in some of the anthracite regions, and made considerable additions to its mileage in north-western Pennsylvania. Various other corporations built main lines or branches which were intended chiefly to reach coke districts in south-western Pennsylvania or to promote the development of bituminous coal districts in Pennsylvania and Maryland.

The longest new line in the Middle states was the West Shore, 448.02 miles, which closely paralleled the New York Central system from New York to Buffalo, and led to an exceptionally severe competitive struggle. It ended in the absorption of the West Shore by the New York Central. Another important new line was the New York, Lackawanna and Western, by which the Delaware, Lackawanna and Western secured an extension to Buffalo. Other new lines which attracted attention were extensions of the Western Maryland into southern Pennsylvania; extensions of the Baltimore and Ohio to Johnstown, Pennsylvania, and from Baltimore to Philadelphia; and the New York, Philadelphia and Norfolk, which extended the Delaware portion of the Philadelphia, Wilmington and Baltimore system to Cape Charles. Some of the most expensive new mileage of the period was composed of short lines intended to improve terminal facilities in Buffalo, Jersey City, Philadelphia, Baltimore, and Pittsburgh.

Illustrations of the tendency to expand systems, interwoven with the disposition to invade contiguous or preoccupied territory, which is one of the notable features of modern railway development, were furnished by a considerable portion of the new construction in the Middle states. In addition to the lines already referred to, which include material extensions of the New York Central; New York, Lake Erie and Western; Pennsylvania; Baltimore and Ohio, and Western Maryland systems, a large amount of work was done upon the South Pennsylvania Railroad, originally intended to serve as the principal portion of a new line between Pittsburgh and Harrisburg, but active labors were interrupted, and it was left in an unfinished condition at the end of 1887. It was originally projected as a virtual extension of the Vanderbilt and Philadelphia and Reading systems. Branches or extensions were built which increased the mileage of the Lehigh Valley; Buffalo, New York and Philadelphia; Rome, Watertown and Ogdensburg, and other roads. In West Virginia there was a considerable amount of new construction, some of which was intended to promote the development of mineral interests, or extensions of the Norfolk and Western system, or the systems of other roads.

NEW CONSTRUCTION IN CENTRAL NORTHERN STATES.

There were a number of noticeable features in the new construction in the Central Northern states. One of the most important was the large proportion of the new lines that fell into the hands of receivers during their infancy. Two classes of roads generally escaped this fate. They were short logging railways traversing the lumber districts, of which a considerable number were built in Michigan, and branches or extensions constructed under the auspices of powerful companies.

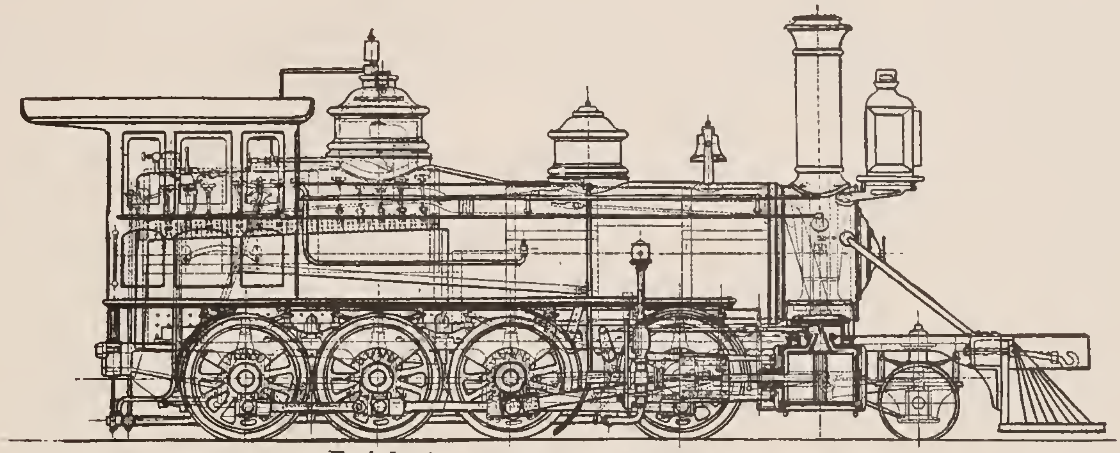
The failure of most of the new companies to pay all the interest on bonds they had issued was due to a variety of causes. In many cases they were built chiefly with the proceeds of bonds, supplemented by very limited cash stock subscriptions. Much of the territory they traversed is subjected to sharp water and rail competition and exceedingly low rates. Some of the roads were intended to form the principal portion, or entire length, of new systems of considerable consequence, which encountered from the outset active rivalry. A portion of the new mileage was built more for the purpose of affording a profit to the projectors than to meet any well-defined public requirement. A narrow-gauge furore stimulated the construction of a considerable amount of mileage which was found to be unprofitable, and was subsequently changed to the standard gauge. In some instances bad judgment and in others bad luck, arising from such shocks to credit as were caused by the panic of 1884, or protracted rate wars, intensified other difficulties.

The two new roads of greatest length and significance were the New York, Chicago and St. Louis, commonly called the Nickel Plate, completed in 1882; and the Minneapolis, Sault St. Marie and Atlantic, completed in 1887. The "Nickel Plate" closely paralleled the main line of the Lake Shore along its entire length, more than five hundred miles, from Buffalo to Chicago. Soon after the road was finished a controlling interest in the stock of the company was purchased by the Lake Shore, and in 1887 a sale in foreclosure took place and the Nickel Plate company was reorganized. The Minneapolis, Sault St. Marie and Atlantic, or the "Soo" route, is nearly five hundred miles in length. It represents an effort to establish a new through rail route to the Atlantic seaboard from Minneapolis, by which a passage through Chicago will be avoided, a connection being made at Sault St. Marie with the Canadian Pacific. A number of its active projectors were deeply interested in the extensive milling interests of Minneapolis and Mackinaw. The Duluth, South Shore and Atlantic was constructed along the southern coast of lake Superior between Duluth and Sault St. Marie, and it furnishes facilities for direct rail connections between the Northern Pacific and Manitoba systems, and Canadian lines leading to Montreal, or branches of the Pennsylvania and New York Central systems in northern Michigan. Another new road of considerable length is the Toledo, St. Louis and Kansas City, extending from Toledo to St. Louis, 451 miles. It was formed largely out of new narrow-gauge mileage, much of which has been changed to standard gauge.

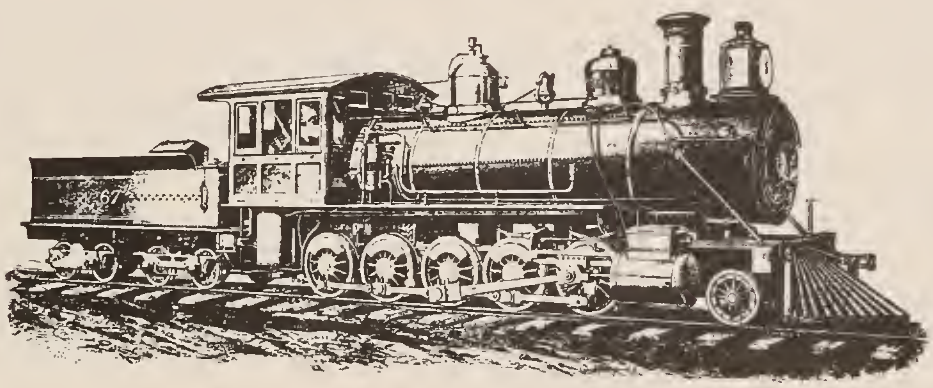
A large percentage of the new roads represents branches of systems that own or operate a considerable amount of mileage in districts not embraced within the Central Northern states. In this category may be included the Chicago and Atlantic, 248.5 miles, completed in 1883, with the expectation that it would practically become an extension of the New York, Lake Erie and Western system to Chicago; an extension of the Atchison, Topeka and Santa Fe system to Chicago; considerable additions to the system of the Chicago, Burlington and Quincy, one of which, the Chicago, Burlington and Northern, 363.51 miles in length, leading from Chicago to St. Paul, is specially important; the construction of a number of branches or extensions of the Chicago, Milwaukee and St. Paul; the Chicago, St. Paul, Minneapolis and Omaha; the Chicago and North-western; the Illinois Central; the Wabash, St. Louis and Pacific; the Grand Trunk, of Canada; the Northern Pacific, and other roads.

To a number of lines or systems, consisting mainly of mileage constructed within the Central Northern states before 1880, considerable additions were made after that year. Extensions or branches were built by the Grand Rapids and Indiana; the Flint and Pere Marquette; the Detroit, Bay City and Alpena; the Indiana, Bloomington and Western; the Indianapolis, Decatur and Springfield; the Jacksonville and South-eastern; the Milwaukee, Lake Shore and Western; the Terre Haute and Logansport; the Toledo and Ohio Central; the Scioto Valley; the Wheeling and Lake Erie, and other roads.

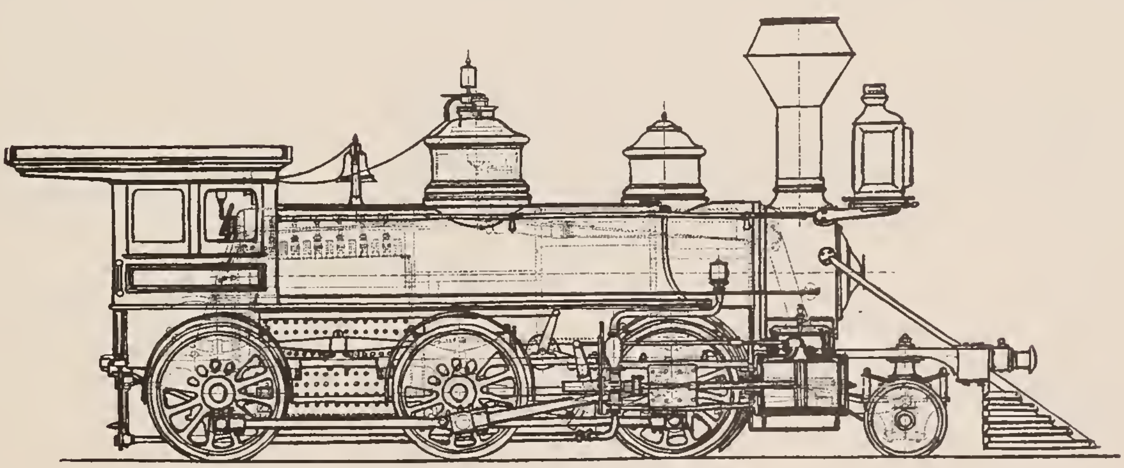
A considerable number of new roads were built, with a length varying from less than five miles to a little more than one hundred miles. They were intended to serve a variety of purposes. A few are belt or terminal roads located in and near important cities. Others are intended chiefly to promote the develop-



Freight Locomotive, Consolidation Type.



Mastodon Locomotive.



Freight Locomotive, Mogul Type.

ment of timber lands or mineral lands, including iron and copper mines, or to increase the market value of land located near cities as sites for suburban residences. In Ohio and Indiana several new bituminous coal roads of considerable importance were constructed. Some of the new lines furnish connections between important towns or cities. In some instances the ultimate destiny of new railways is subject to contingencies. They may become parts of either of several systems, or possibly serve as the foundation of a new system of considerable magnitude by being allied with adjacent roads and additional construction.

NEW CONSTRUCTION IN SOUTH ATLANTIC STATES.

A considerable portion of the new construction in these states has furnished useful links or extensions to southern systems expanded during late years, including the Richmond and West Point Terminal, the Norfolk and Western, the Seaboard and Roanoke, the Plant system, the Central Railroad and Banking Company of Georgia, and the Louisville and Nashville. Virginia furnishes the seaboard outlet for railway combinations of considerable magnitude, one not already referred to being the Newport News and Mississippi Valley, and the efforts of these and other southern systems to expand their sphere of operations had an important bearing on much of the mileage constructed during the ninth decade. Prominent objects of various lines were to improve connections leading in southern, south-eastern, or south-western directions, as well as westward from the Atlantic coast or northward from the gulf of Mexico.

The new construction in Virginia included 55 miles of the Atlantic and Danville, built in 1885, and other extensions at a later date; the Norfolk and Virginia Beach, 17.8 miles, built in 1883; several extensions of the Norfolk and Western, including the Norfolk Terminal; the Norfolk Southern, 73 miles, extending from Virginia into North Carolina; the Richmond and Alleghany and branches, 256 miles, built about 1881.

In North Carolina new mileage included 32 miles built by the Albemarle and Raleigh; 21 miles by the Asheville and Spartanburg; about 200 miles by the Cape Fear and Yadkin Valley; 125 miles by the Carolina Central; 71 miles by the Marietta and North Georgia; 20 miles by the Meherrin Valley; 13 miles by the Oxford and Henderson; 10 miles by the Raleigh and Augusta Air Line; branches of the Wilmington and Weldon, and of the Western North Carolina; and some construction by other companies.

New construction in South Carolina included 40 miles by the Central of South Carolina; 44 by the Charleston, Cincinnati and Chicago; 34.75 by the Eutawville; 37.50 by the Georgetown and Western; nearly 200 miles of extensions or branches of the Port Royal and Western Carolina, portions of which are located in Georgia; 65 miles by the Wilmington, Chadbourn and Conwayboro', a portion of which is in North Carolina.

New construction in Georgia included 48 miles by the Americus, Preston and Lumpkin; 80 miles by the Augusta and Sandersville; 27 miles of extensions by the Columbus and Rome; 50 miles by the Covington and Macon; 97 miles by the Georgia, Midland and Gulf; 318 miles by the Georgia Pacific, some of which is located in Alabama and Mississippi; 10 miles by the Lawrenceville branch; 22 miles by the Rome and Carrollton; 15 miles by the Sylvania; 7 by the Talbotton; 35 by the Wrightsville and Tennille, and 9 by the Roswell. Other construction was progressing in 1887, or had been completed in or previous to that year, two of the most important projects being 135 miles undertaken by the Rome and Decatur, and 253 miles by the Savannah, Dublin and Western.

A leading feature of the new construction in the South Atlantic states is the large additions made to the mileage of railways traversing Florida. This may be partly due to the fact that that state has become a favorite winter resort for visitors from many sections, including a considerable number of railway projectors and capitalists, and partly to land grants. In 1879 a considerable portion of the state possessed no railways. The new roads or extensions built or well advanced towards completion during a comparatively recent period include the following: Blue Spring, Orange City and Atlantic, 30 miles; Florida Midland, 20; Florida Southern, 307.54; Jacksonville and Atlantic, 17; Jacksonville, Tampa and Key West, 240; Orange Belt, 148; Pensacola and Atlantic, 160; Silver Springs, Ocala and Gulf, 65; South Florida, 205; Tavares, Apoka and Gulf, 55; Western, of Florida, 65.

NEW CONSTRUCTION IN GULF AND MISSISSIPPI VALLEY STATES.

In this region, as in nearly all others, a leading object of a considerable proportion of the new construction of the ninth decade was to expand old systems or to create new ones.

The Louisville and Nashville system traverses all the states named above except Mississippi; and it built a number of extensions or branches in Kentucky, Alabama, and Tennessee. In 1887 it had under construction, with the expectation that the lines would be completed during that year, an extension of the Bardstown branch, 22 miles; the Indiana, Alabama and Texas branch, 57 miles; a branch from Corbin to Pineville, Kentucky, 30 miles; an extension of the Nashville and Florence, 25 miles. Work was also progressing on a road intended to establish a convenient connection with the Norfolk and Western. In previous years of the decade it had completed a number of branches or extensions, including several hundred miles of new road in Kentucky, Alabama, and Tennessee. Its system has been rapidly expanded in all directions, partly by new construction, but more especially by the acquisition of a controlling interest in a number of connecting lines, and it has made zealous efforts to build up iron and coal interests.

The Richmond and West Point Terminal Company system extends through the gulf states, and a portion of the new construction in them represents additions to mileage. One of the most important of these is portions of the Georgia Pacific. Work on parts of its line in Mississippi was progressing in 1887.

One of the important new lines of the region was the New Orleans and North-eastern, 196 miles in length, completed in 1883. It forms part of the Erlanger system, and that system also controls the Vicksburg, Shreveport and Pacific, 189 miles, opened in 1884.

Additions were made, during the decade, to the southern portion of the Illinois Central system, which include the Canton, Aberdeen and Nashville, 88 miles, opened in 1884; and the Yazoo and Mississippi Valley, 115.69 miles, one portion of which was opened in 1884 and another in 1886.

A considerable portion of the new mileage of the region consists of lines intended to reach or radiate from Birmingham, Alabama, which has become an important railway centre. One of these new lines was the Mobile and Birmingham, with a projected length of 250 miles, of which 56 miles were completed in June, 1887. Another important road leading to Birmingham was being constructed in 1887 by the Kansas City, Memphis and Burlington Railroad Company. It is 251 miles in length, running in a south-western direction from Memphis through Tennessee and Mississippi, and was completed in October, 1887. Of the East and West Railroad, of Alabama, which is projected from Gainesville, Georgia, to Birmingham, 117 miles were completed.

One of the influences affecting new construction in the Gulf and Mississippi Valley states was a great increase of the desire to develop iron and coal industries. The Tennessee Central, a narrow-gauge road 140 miles in length, was opened in 1882, to be used as a coal road. The Sheffield and Birmingham, about 87 miles in length, was opened in 1885, and it was subsequently consolidated with the Alabama and Tennessee Coal and Iron Company. The new company owns the railroad, 70,000 acres of coal and iron lands in Alabama, and 60 acres of land in Sheffield. Various short lines and branches were constructed under similar combinations of mineral and railway interests.

A number of other new roads or branches were constructed during the decade. The list includes the Anniston and Atlantic, 53 miles, in Alabama; the Chesapeake and Nashville, 35 miles, completed in 1887, and more than 200 projected; the East Tennessee and Western North Carolina, 34 miles; the Montgomery and Florida, 50 miles, in Alabama; the Nashville and Florence, 51 miles, in Alabama; the Natchez, Jackson and Columbus, 57 miles, in Mississippi; the Natchez, Red River and Texas, 25 miles, in Louisiana; the New Orleans and Gulf, 65 miles, in Louisiana; and a considerable number of shorter lines, together with various lines of greater length which were under contract in 1887.

NEW CONSTRUCTION WEST OF THE MISSISSIPPI.

MORE than sixty per cent. of the new construction of the ninth decade was in states and territories lying west of the Mississippi river. This vast region affords ample space for extensive additions to mileage, and questions raised in regard to the probable future of some of the lines are based chiefly on sparsity of population and length of time required to attract immigration.

In compilations of railway statistics it is usually divided into three sections, respectively styled north-western, south-western, and Pacific, or far western states, and in each of these sections railway construction was conducted on an extensive scale. Great systems were expanded and created. Four important new transcontinental lines leading from the Missouri or states west of the lower Mississippi to the Pacific coast were completed. In a number of the states and territories embraced in the divisions the amount of new construction was of unprecedented magnitude. There is no other portion of the world in which greater and more numerous feats of rapid construction were ever performed.

SYSTEM OF RAPID TRACK-LAYING.

Out of the necessity or desirability of quick movements, the existence of such favorable physical conditions as exist on the plains, and the absence of obstructions arising from a high state of cultivation and numerous settlements, a system of rapid railway track-laying was developed, which, with various modifications, facilitated a considerable proportion of the new construction west of the Mississippi. The following description of this system, as applied to the class of work styled "prairie grading," on 500 miles of the Canadian Pacific, in 1882, by Messrs. Langdon & Shepherd, a firm of American constructors, forms part of a paper written by Henry Purden Bell for the Institution of Civil Engineers:—

"When a train load of sleepers was forwarded it was unloaded by 30 men, who reloaded the same on 35 two-horse wagons, which were sent to the front as soon as possible.

At the end of the track 6 men unloaded these sleepers, and 20 more put them in place ready to receive the rails as they were removed from the iron car.

The rails were unloaded from the trains in quantity equal to half mile of track at a time, and sleepers for the same distance. Twelve men unloaded the rails, and when the train moved back these same men reloaded these rails upon the iron cars, which were sent forward, with two horses to each car. These horses traveled as fast as possible to the end of the track.

The iron car resembled in its proportions an ordinary low 4-wheeled truck, and was furnished with four rollers to neutralize the friction encountered in pulling the rails from the iron car and dropping each length in place upon the sleepers. Four of these cars were used in getting the rails to the end of the track, and the method of operating them was as follows: At the beginning of the day's work the four iron cars stand upon the track in front of the boarding car, the track being clear to the end. The foremost car is taken to the pile of rails, there loaded, and sent to the front at once. Another iron car is then pulled forward to take its place. By the time that the car first forwarded has been unloaded, the second car loaded is upon the track immediately behind it. The first car is then lifted up, with its side resting on the ends of the sleepers clear of the rails, and the loaded car is passed by it to be handled by the track-layers. The first car, on its return to the rail pile, meets there a third car loaded, and is again lifted as before described, and the loaded car drawn forward, leaving the third car ready to start for the end of the track. Briefly described, the operations of these cars consist of passing and repassing each other, in the mode described, between the pile of rails and the end of the track. Immediately behind the forward iron car at the end of the track are 12 men putting on fish-plates and full-bolting them; these men do nothing else, but they are obliged to keep pace with the laying of the rails, in order to leave the track joints in the position for the car coming behind.

Behind the bolters are 6 men distributing track spikes, commonly called 'spike peddlers.'

The mode of distributing sleepers in America originated the use of the term 'line side of the track;' that is to say, that side of the track upon which the line is stretched with which the sleeper ends are made to coincide, and is generally the right-hand side facing the track end, but which side is immaterial. The side opposite the line side is called the 'gauge side.' Track-spiking is divided into joint, quarter, and centre spiking.

After the six men described as spike peddlers come two men called line spikers, accompanied by a nipper, who holds up the end of the sleeper with a bar while the spikes are being driven. These two men spike the sleeper upon either side of the rail joint, but only upon the line side of the track. Opposite these two spikers and the nipper is a similar gang to spike the joints upon the gauge side of the track, first using the gauge to place the rail ends the proper distance apart. Immediately behind the two line spikers come the two quarter spikers and a nipper, and opposite to these another set of gauge spikers. Behind these again are the centre spikers and nipper, with their gauge spikers opposite, the duty of each gang being exactly the same.

It will, therefore, be seen that the gauge of the track has been tested at five different points within the length of each pair of 30 foot rails, and is practically perfect.

To each 30-foot rail are 15 sleepers two feet apart from centre to centre, and upon each side of the track are 16 spikers and 8 nippers, 48 men in all, including all the line and gauge spikers before mentioned. The spiking is, therefore, done in exact rotation by one gang following the next ahead to a sleeper in similar position each successive length of rails. Behind the gangs just described are six men and a foreman, throwing the track into exact line, which completes the operation of track-laying. To give an idea of the speed and precision attained by this method of track-laying, it may be stated that during the month of August, 1882, 92.6 miles were completed, the maximum distance in any one day being 4½ miles. Mr. Donald Grant, who was in charge of operations at the end of the track, offered to lay, for the members of the Dominion Press Association, who visited the work in August, 1882, one mile of track in one hour. The association remained upon the ground for half an hour, and saw the completion of half a mile. After the track has been properly lined, the work next in order is called surfacing, which consists of leveling lumps, filling holes, and bringing the holes to grade, or as near as possible thereto. This is effected by raising any low portions of track and rebedding the ties with material taken from the slope shoulders on each side. The form of embankment thus made is called a rain section, and this last operation leaves the track in order for the running of trains.

Briefly summarizing, the track-laying gang consisted of: Thirty men unloading and reloading sleepers; 6 men unloading sleepers from teams; 20 men placing sleepers to receive rails; 12 men pulling rails from iron cars to sleepers; 6 men, spike peddlers; 12 men, bolters; 6 men, runners with iron cars; 12 men, unloading and reloading rails; 32 men, spikers; 16 men, nippers; 7 men, liners; 159 in all.

Besides these, there are 35 teams and 35 teamsters distributing sleepers under the direction of two foremen, making a grand total of 196 men and 70 horses in and connected with the business of track-laying."

GREAT MAGNITUDE OF NEW CONSTRUCTION WEST OF THE MISSISSIPPI.

All the railway building in the entire United States up to the end of 1866 resulted in putting a smaller number of miles in operation than are represented by the lines built west of the

Mississippi in eight years. Such labors would have been impossible if the influences by which they were sustained had not been of corresponding magnitude. They were largely speculative, but also based, in a great measure, on a legitimate demand for additional railway facilities, which grew out of the enormous westward emigration of native and adopted citizens after the panic of 1873, and its active continuance, during a period when the surplus products to be transported eastward, the merchandise and building material to be taken to numerous settlements, and the local traffic developed, rapidly increased.

In the group of north-western states the expansion was approximately as follows:—

	Mileage at end of 1879.	Mileage at end of 1887.	Increase.
Iowa	4,779	8,286.80	3,507.80
Minnesota	3,008	5,019.11	2,011.11
Nebraska	1,634	4,716.89	3,082.89
Dakota	400	4,458 21	4,058.21
Wyoming	593	910.72	317.72
Montana	....	1,678.48	1,678.48
	10,414	25,070 21	14,656.21

In the group of south-western states the increase was approximately as follows:—

	Mileage at end of 1879.	Mileage at end of 1887.	Increase.
Missouri	3,740	5,622.32	1,882.32
Arkansas	808	2,348 68	1,540.68
Texas	2,591	8,350.27	5,759 27
Kansas	3,103	8,189.40	5,086.40
Colorado	1,208	3,761.56	2,553.56
New Mexico	118	1,590.96	1,472.96
Indian Territory	275	930 57	655.57
	11,843	30,793.76	18,950.76

In the group of Pacific states the increase was approximately as follows:—

	Mileage at end of 1879.	Mileage at end of 1887.	Increase.
Washington Territory	212	1,005.90	793.90
Oregon	295	1,267.41	972.41
California	2,209	3,654.76	1,445.76
Nevada	720	958.18	238.18
Arizona	183	1,058.95	875.95
Utah	593	1,144.97	551.97
Idaho Territory	196	865.28	669.28
	4,408	9,955.45	5,547.45

COMPANIES THAT CONSTRUCTED RAILWAYS IN THREE OF THE GROUPS.

The gigantic scale on which important companies provided enormous additions to mileage is illustrated by the fact that several of them had new construction advanced under their auspices in three of the groups. No single state or territory, and not even single great combinations of states and territories, afforded a sufficiently extensive field for their operations.

The Northern Pacific, in building to the Pacific coast, traversed the Pacific states, while it was constructing branches or connections in the north-western states, and fostering eastern extensions in the group of central northern states. In 1880 the average number of miles it operated was 722, and in 1886 it was 2,718. The total length of all its lines June 30th, 1886, was 2,808.31, and during 1886–87 additions of considerable significance were made to its system. In March, 1888, it had 2,170.4 miles of main line and 1,091.1 miles of leased lines in operation. The increase from 1880 to 1888 consisted chiefly of new mileage constructed during the ninth decade, in three groups, and the opening of the principal portion of its main line, in 1883, was a leading railway event of that period.

The Southern Pacific completed a line in 1887 which opened up connections between northern California and southern Oregon, and furnished a continuous rail route between Portland, Oregon, and New Orleans. This line traverses three groups, the Pacific Coast, South-western and Gulf, and Mississippi Valley. The distance is 3,241 miles. A large portion of this line, together with a number of branches and extensions, were constructed during the ninth decade, the road being extended from south-eastern California through Arizona and New Mexico, to El Paso, where a connection is made with Texas and Louisiana roads, leading to Galveston and New Orleans. A large proportion of their mileage was put in operation since 1879, and, like the original Southern Pacific, it has been leased to the Southern Pacific Company, chartered under the laws of the state of Kentucky in 1884, which controls, in addition to the lines named, those of the Central Pacific. At the end of 1886 the mileage of its Pacific system was 3,138.98, and of its Atlantic system, consisting chiefly of its Texas and Louisiana roads, 1,607.55, a total of 4,846.53. In March, 1888, the reported length of its rail lines was 4,976.23.

Another company which holds a very prominent rank among those that built railways in three groups during the ninth decade is the Atchison, Topeka and Santa Fe. It was said of this company that it received during a recent year a larger sum of money applicable to new railway construction than had ever previously been obtained by any other organization. It is deeply interested in a number of leased and auxiliary roads, some of which are operated under their own organizations. During late years it has expanded its system through the south-western and Pacific states, and also by an extension to Chicago through the central group of northern states, with extraordinary rapidity. In 1879 it operated 1,167 miles of main line and branches. In the early part of 1888 it owned, leased, controlled, or was part owner of 7,374 miles of railway, classified as follows: Atchison system, 2,080.85; Southern Kansas system, 935.50; Sonora system, 350.19; owned jointly (one-half mileage), 113.78; sundry lines owned entirely or controlled, including the Chicago, Santa Fe and California, 498.25; Chicago, Kansas and Western (all in Kansas), 903.16; Gulf, Colorado and Santa Fe, California Southern, California Central, and other roads, 2,974.83; Atlantic and Pacific, controlled jointly with the St. Louis and San Francisco, 918.86. The principal portion of the increased mileage was constructed after 1879. It represents numerous extensions in Kansas, leading on the west into Colorado and New Mexico, and thence through Arizona, by the Atlantic and Pacific, into southern California, with a branch leading into north-western Mexico, and a close connection at El Paso with the Mexican Central, while from eastern Kansas a line (the Gulf, Colorado and Santa Fe) was constructed that leads through the Indian Territory and Texas to Galveston, Texas.

COMPANIES THAT CONSTRUCTED RAILWAYS IN TWO OF THE GROUPS WEST OF THE MISSISSIPPI.

Several companies constructed railways in two of the groups west of the Mississippi. One of these was the Union Pacific, which greatly enlarged its mileage, partly by purchases or consolidations, and partly by building, during the ninth decade. The average number of miles of road operated by its system was 2,706.30 in 1880 and 4,548.13 in 1886. The reported length of its system in May, 1888, was 5,134.3 miles, subdivided as follows: Nebraska division, 893.3; Wyoming division, 687.2; Kansas division, 1,209.0; Colorado division, 844.7; Idaho division, 1,019.4; Salt Lake and Western, 57.2; Montana Union, 61.0; Utah Central, 285.5; Utah and Nevada, 37.0. The branches or extensions constructed include lines located in Wyoming Territory, Colorado, Utah, Montana, Nebraska, and Oregon. By the construction of the Oregon Short Line, more than six hundred miles in length, and a connection with the Oregon Railway and Navigation lines, it secured an outlet to the Pacific coast independent of that afforded by the Central Pacific, and by a comparatively short extension of a line it controls in south-western Utah another Pacific coast connection may be secured by a junction with the line of the Atlantic and Pacific.

Other companies extended their systems in more than one of the groups west of the Mississippi, but their operations will be more particularly referred to in connection with the new construction in the groups in which they made their principal additions to mileage. The list includes the Chicago, Milwaukee and St. Paul, the Chicago, Rock Island and Pacific, and the Missouri Pacific.

NEW CONSTRUCTION IN THE NORTH-WESTERN STATES.

The new construction in the north-western states consisted largely of enormous additions made to the mileage of great systems radiating from Chicago, or St. Paul and Minneapolis. Their growth has been one of the marvels of modern railway history, and at no period was their expansion more rapid than in the ninth decade.

The length of the lines owned and operated by the Chicago, Milwaukee and St. Paul in February, 1880, was officially reported to be 2,251 miles. The total number of miles of single track, main line, at the end of 1887 was 5,669.95. A large percentage of this increase of 3,418.95 miles consists of new lines, located chiefly in the group of North-western states; but one important branch, the Kansas City extension, extends through Missouri, while others were in Wisconsin. The mileage of this system is specially large in Wisconsin, Iowa, Minnesota, and Dakota.

The Chicago and North-western in March, 1888, operated 4,101 miles of its roads and controlled 1,339 miles of the Chicago, St. Paul, Minneapolis and Omaha, 723 miles of the Fremont, Elkhorn and Missouri Valley, 77 miles of Wyoming Central, and 107 miles of Sioux City and Pacific, the total owned and controlled being 6,347 miles. At the end of its fiscal year, on May 31st, 1880, it owned and controlled 2,513 miles. The increase of 3,834 miles, although composed partly of acquired lines that were completed before 1880, consists chiefly of lines constructed during the ninth decade, including numerous branches and extensions, in the group of north-western states. One of the longest of the new lines is the Fremont, Elkhorn and Missouri Valley, which extends to the Black Hills.

The length of lines operated by the Chicago, Burlington and Quincy on January 1st, 1880, was 1,856 miles. By purchases, consolidations, and new construction its system was greatly extended during the ninth decade. In March, 1888, its system included 2,063.03 miles in Illinois, Iowa, and Missouri; 2,738 miles of the Burlington and Missouri River Railroad in Nebraska; and it controlled interests in other companies operated by their own organizations. These lines combined, reach Chicago on the east, St. Paul on the north, St. Louis on the south, Cheyenne, Denver, and more western points in Colorado on the west. The rapidity with which some of the extensions, particularly those leading into Colorado and Minnesota were constructed, and the effect of these extensions on pre-existing railways attracted much attention. The new construction in 1887 consisted of 9 miles in Missouri, 439 in Nebraska, 36 in Kansas, 344 in Colorado, and 29 in Wyoming.

Another system greatly expanded during the ninth decade, by new construction within the territory embraced in the groups of north-western states, is that of the St. Paul, Minneapolis and Manitoba. At the close of 1879 or early portion of 1880 it operated 667 miles. In March, 1888, it had in operation 2,685.44 miles. This increase of more than 2,000 miles is made up chiefly of new construction. The longest of the new lines extends from eastern Dakota to western Montana, and work upon it was advanced with extraordinary rapidity in 1886–87.

The bulk of the new construction in the north-western group, during the ninth decade, was advanced mainly by parties identified with the systems named above, and the Northern Pacific. There was, however, a considerable amount of new work done by other parties, either for the development of local interests, the creation of new systems, or the increase of the mileage of other systems. The Chicago, Rock Island and Pacific controls a considerable amount of mileage opened since 1879 in this group, but its most active theatre of expansion was in the south-western group.

One of the most important new systems opened in the group, extending into adjacent groups, is the Chicago, St. Paul and Kansas City Railway, formed by a consolidation of the road formerly bearing that name with the Minnesota and North-western. In the early part of 1888 the length of the consolidated lines was reported to be 827 miles, nearly all of which was constructed after 1879.

There was a considerable amount of new construction during the decade on branches of the Burlington, Cedar Rapids and Northern, one of which, the Cedar Rapids, Iowa Falls and North-western, had 430 miles of road opened in 1880, '81, '82, '84, '86. Other roads opened or extended during the decade were the Duluth and Iron Range, leading northward from Duluth to Tower, in Minnesota, 96 miles, opened in 1886; the Burlington and Western, 70.70 miles, opened in 1884; Des Moines, Osceola and Southern, 111.11 miles, opened in 1884; branches or extensions of the Minneapolis and St. Louis, and a number of comparatively short lines.

The work of the decade has left a permanent impress upon the north-western states, the approximate gains in railway mileage from the end of 1879 to the end of 1887 being 3,507 miles in Iowa, 2,011 in Minnesota, 3,082 in Nebraska, 4,058 in Dakota, 217 in Wyoming, and 1,678 in Montana. The largest amount of building in any single state or territory in the group appears to have been in Dakota. Its northern portion has been supplied with an extension of the St. Paul, Minneapolis and Manitoba, and numerous branches of that road and the Northern Pacific, while its southern portion is traversed by numerous branches of those roads and extensions of the Chicago, Milwaukee and St. Paul, Chicago and North-western, and other systems. Montana, which had no railways before 1880, is now traversed by the Northern Pacific and an extension of the St. Paul, Minneapolis and Manitoba, and reached by a branch of the Union Pacific. Nebraska was made the theatre of a large amount of new construction by companies identified with the Chicago, Burlington and Quincy system, and also by companies identified with the Chicago and North-western Railway system. Considerable additions were made to the mileage of most of the great systems by which Iowa is traversed, and some important new roads were constructed.

NEW CONSTRUCTION IN THE SOUTH-WESTERN STATES.

The particularly active theater of new construction was the south-western states and territories. Various causes contributed to this result. One was the initiation of a series of enterprises which had northern, north-eastern, and north-western Mexico as objective points, and the construction of connecting railway links within the boundaries of Mexico, which were under the direction of American capitalists and managers. Others were the growing importance of Kansas City as a traffic centre, and the increasing disposition of a portion of the population of Colorado and other states to seek an outlet for surplus agricultural products at gulf ports. There was also a growing desire to hasten railway development in the Indian Territory; an increase of the commercial importance of the cattle trade, which served as an incentive to some of the new construction; movements in a variety of directions, some being towards New Orleans, and others towards Kansas City, Galveston, or St. Louis; modifications of political, industrial, financial, and speculative conditions, which had the general effect of redirecting to the south-west energetic forces temporarily diverted from that region by the civil war and succeeding events; and a belief that there were fewer natural obstacles to construction and operation of railways in many portions of the south-west than in more northern districts, in which it was necessary to encounter rugged mountains and inclement seasons. Aside from these considerations is the immense area embraced within the south-western group, and the classification, as part of it, of Kansas, in which state there was a very large amount of new construction.

One of the most important enterprises in the south-west, that attracted attention during the early years of the ninth decade, was the extension of the lines of the Texas and Pacific. In 1882 its Rio Grande division, 616 miles in length, was opened, and in the same year the New Orleans division, 374 miles, was completed. The Southern Pacific, whose operations have already been referred to, reached El Paso in 1882, making there a junction with the Texas and Pacific, and completing arrangements for the extension of its system into Texas, and subsequently to New Orleans. Other important features of the new construction in Texas consist of extensions of the system of the Atchison, Topeka and Santa Fe, which have already been briefly discussed in references to the operations of that company. Soon after the completion of the Texas and Pacific it was temporarily attached to the Missouri Pacific system, to which, in Texas and other portions of the south-west, especially Kansas, very large additions of mileage were made during the ninth decade. While a number of them consisted of lines leased or consolidated, they also included much new construction, and in general terms it may be said that the Missouri Pacific, the Southern Pacific, and the Atchison, Topeka and Santa Fe were three of the greatest railway builders in the south-western group during the first eight years of the ninth decade. Of the

MISSOURI PACIFIC EXTENSIONS AND BRANCHES

it was reported that it had constructed in 1886 new lines located in the states of Missouri, Kansas, Nebraska, Arkansas, and Texas. During the year ending December 31st, 1886, it had completed and put in operation 517 miles, and there was then under construction unfinished 758 miles. The reported addition to the Missouri Pacific system during 1887 was 2,137 miles, exclusive of the Little Rock and Fort Smith, 169 miles, acquired and operated as an independent property.

One of the most important of the extensions of the Missouri Pacific system completed in 1887 entered eastern Colorado, reaching Pueblo. Its other new lines were numerous, most of them consisting of short branches in Kansas and elsewhere. The Missouri Pacific system is one of the largest in the country. In March, 1888, it operated 7,043 miles, classified under the following heads: Missouri Pacific, 2,357 miles; St. Louis, Iron Mountain and Southern, 1,144; Fort Scott, Wichita and Western, 306; Missouri, Kansas and Texas, 1,611; International and Great Northern, 825; Central Branch Union Pacific, 397; other lines, 403 miles. Aside from the main lines of the leading portions of the system, the mileage consists largely of roads constructed after 1879.

Another road that engaged extensively in new construction in the south-west at a comparatively recent period was the

CHICAGO, ROCK ISLAND AND PACIFIC.

By acquisition and construction it secured important lines leading through Missouri to the borders of Kansas, and extensive lines leading through that state, and southern Nebraska, were constructed by the Chicago, Kansas and Nebraska Railway Company, which received substantial financial support from the Chicago, Rock Island and Pacific. The reported amount of track-laying, in connection with these enterprises, in 1887, was 656 miles, and additional construction, leading to Colorado on the west, and through the Indian Territory on the south, was anticipated at the end of that year.

OTHER SOUTH-WESTERN SYSTEMS.

Another system constructed throughout since 1879 is that of the St. Louis, Arkansas and Texas. Its lines extend through north-eastern Texas, a small portion of north-western Louisiana, from the south-western to the north-eastern portion of Arkansas, and through the south-eastern portion of Missouri, and it was reported in April, 1888, that their aggregate length was then about 1,200 miles.

The St. Louis and San Francisco system was materially enlarged. At the end of 1879 its line of road consisted of 327 miles from Pacific, Missouri, to Vinita, Indian Territory, and a branch from Pierce City, on main line, to Wichita, Kansas, 227 miles; total, 554 miles. In March, 1888, the company operated 1,446 miles, located in Indian Territory, Missouri, Texas, and Kansas. The increase consists chiefly of new lines constructed after 1879.

In addition to these extensions, the St. Louis and San Francisco united in January, 1880, with the Atchison, Topeka and Santa Fe in a joint and successful effort to promote the construction of the Atlantic and Pacific Railway, which, by connection with the Southern Pacific, formed a new through route to the Pacific coast. The total length of the lines owned and leased by the Atlantic and Pacific on December 31st, 1886, was 931.05 miles.

A notable feature of the construction of the ninth decade was the exceptionally large amount of new mileage on roads leading to or from the gulf of Mexico. In addition to the Gulf, Colorado and Santa Fe, already referred to as part of the Atchison, Topeka and Santa Fe system, the San Antonio and Aransas Pass had in operation in March, 1888, several hundred miles of main line, most of which had been completed in 1887.

The Kansas City, Springfield and Memphis built 282 miles of road in 1884, leading from Springfield, Missouri, to Memphis. It forms part of a through line now extending from Kansas City to Birmingham, Alabama, from which point a railway extension to the gulf of Mexico is projected.

A combination of roads leading from Denver City to Fort Worth, and from that point to Galveston, Texas, or to New Orleans, commenced active operations over the entire system in April, 1888. It forms a through route between Denver and cities of the gulf coast. Portions of the road were opened at various periods since 1880. It was estimated that the length of the through route between Denver and Galveston would be about 800 miles.

The Denver and Rio Grande system, of Colorado, on January 1st, 1880, consisted of 340 miles. Important extensions were completed during 1880, which, with additions completed at late periods, including the Denver and Rio Grande Western, made the length of the lines in operation in March, 1888, 1,684.7 miles. The western terminus of the Denver and Rio Grande extension is at Ogden, Utah, where a connection with the Central Pacific is made, and a new through route from the Missouri river to Ogden was formed during the ninth decade by this combination and a close connection on the east with the Chicago, Burlington and Quincy system. In 1887 contracts were let for about 161 miles additional extensions of the Denver and Rio Grande system.

A new road opened in Colorado is the Colorado Midland. One hundred miles from Colorado Springs westward were completed July 1st, 1887, and in March, 1888, it had in operation 221 miles, extending to Glenwood Springs, exclusive of a branch, 17 miles in length, leading to Aspen.

Other roads were constructed in the south-western group during the ninth decade, and numerous branches or extensions of large systems were built, to which particular reference has not been made.

NEW CONSTRUCTION IN THE PACIFIC STATES.

A considerable portion of the new construction in the Pacific states, during the ninth decade, has already been incidentally referred to, as it consisted of extensions of the Northern Pacific to the Pacific coast, the construction of the Oregon Short Line by the Union Pacific, material additions in California and Arizona, to the systems of the Southern Pacific and the Atchison, Topeka and Santa Fe, and the Denver and Rio Grande Western.

The largest amount of new construction by any other single company was probably completed by the Oregon Railway and Navigation Company, which, from 1879 to September 1st, 1886, added 675 miles to the length of its lines, chiefly in Oregon. Much of this mileage forms the northern outlet of the Union Pacific system to the Pacific coast, from Huntington, the western terminus of the Oregon Short Line.

Other new construction in Oregon embraced work on the following lines: Oregon Pacific, about 58 miles completed up to end of 1887, and about 105 miles then under construction. Portland and Willamette Valley, about 26 miles completed in 1887.

In Washington Territory the new track laid in 1887 included 47 miles on the Spokane and Palouse, and 28 miles by the Seattle, Lake Shore and Eastern.

In California the new track laid during the ninth decade included the following: 121 miles of extensions to the Atchison, Topeka and Santa Fe system in 1887, in addition to other extensions in preceding years, one of the most important of which was the California and Southern, 210 miles completed in 1885; Brodie and Benton, 36 miles completed in 1882; Colusa and Lake, 22 miles in 1885–86; Nevada and California, 31 miles completed in 1882, 8 miles in 1887, and 47 miles then under construction; Pacific Coast, 63.8 miles constructed in 1882, and 14 miles in 1887; San Joaquin and Sierra Nevada, 39.6 miles in 1885; San Pete, 33 miles in 1882; Sonoma Valley, 21.50 miles in 1882. On various branches of the Southern Pacific system, in addition to the construction of previous years, about 207 miles of track were laid in 1887, and it had then under construction about 158 miles.

In Idaho, in addition to the branches constructed by the Union Pacific previous to 1887, the track laid during that year included the following: Cœur d'Alene Railway and Navigation Company, 19.5 miles, and 10 miles under construction; Idaho Central, 20 miles.

The additions to new mileage in Nevada included the following: Carson and Colorado, 299 miles, opened in 1881–82–83; Nevada Central, 93.5 miles, opened in 1880.

New construction in Arizona includes, in addition to the mileage which forms part of the main lines of the Southern Pacific, and Atlantic and Pacific, the following: Arizona Mineral Belt, 36 miles of track laid in 1887; Maricopa and Phœnix, 34.95 miles in 1887; Prescott and Arizona Central, 73 miles in 1886.

EXPANSION AND CONNECTION OF RAILWAY SYSTEMS.

PARTLY on account of the large amount of new construction promoted by single organizations, especially west of the Mississippi, and partly on account of numerous consolidations, there was a remarkable increase in the mileage of many of the railway systems of the United States during the period from 1879 to 1888. Except in a few instances, in which there were special causes for disruptions, gains of varying significance were universal among powerful and prosperous companies.

While this change was progressing nearly all the railway companies engaged in the through movements of different regions increased the closeness of their connections, to an extent that made them, in the aggregate, one system in a fuller sense than at any former period. A tendency toward the removal of obstacles to the free interchange of traffic continued to gain strength for some years, and much was done during comparatively recent periods, by the practical abolition of nearly all exceptional gauges, and the virtual establishment of a uniform national standard of 4 feet 8½ inches on many roads, and of the interchangeable standard of 4 feet 9 inches on many other roads, to facilitate the convenient and economical interchange of cars and traffic.

During the interval from 1880 to 1888 many of the narrow-gauge roads were changed into standard-gauge lines, or a third rail laid down, which supplied a standard-gauge track, and nearly all the southern lines which formerly maintained a 5-foot gauge narrowed their tracks so as to make them conform to the standard gauge.

The last-named change was effected chiefly during the months of May and June, 1886, and the new standard generally adopted was 4 feet 9 inches, which is the standard used on the Pennsylvania system.

The list of roads that participated in the movement include the Atlantic Coast Line south of Wilmington, North Carolina; Richmond and Danville; Norfolk and Western; East Tennessee, Virginia and Georgia; Louisville and Nashville; Nashville and Chattanooga; Cincinnati Southern; Alabama Great Southern; Western and Atlantic, and various other tributary or connecting lines, that traverse districts south of the Ohio and Potomac, and east of the Mississippi. The new order of things necessitated a change of locomotives and cars as well as of tracks, and the cost of the required movements was roughly estimated at an average of about $150 per mile for 14,000 miles, or $2,100,000, and on a number of lines more than half of the outlay was for changes in the rolling stock.

Several important roads traversing districts adjacent to those in which the standard gauge was adopted in 1886 had previously conformed to it. The Mobile and Ohio, for instance, completed its change of gauge in 1885, and the roads of the Seaboard Air Line, and of the Chesapeake and Ohio system were previously of the standard gauge. The change of 1886 was, therefore, necessary to establish a uniform gauge among the southern lines, as well as to make the standard prevailing in the Southern states conform to the gauge adopted in all other portions of the country. The leading result of the change was indicated by the statement that, in consequence of it, after June 2d, 1886, a passenger or freight car could leave Portland, Maine, or Portland, Oregon; San Francisco, Chicago, or any prominent railway centre, and traverse without change of trucks or bulk every mile of southern road leading to New Orleans, Texas, or Florida.

Another set of new improvements which provided a material increase of facilities for interchanging traffic at leading centres was the construction of a number of belt railways, or roads leading between different railway stations and depots after 1880.

One of the clauses of the interstate-commerce act will presumably prevent sundry obstructions that were occasionally created before its passage. It provides that "every common carrier subject to the provisions of this act shall, according to their respective powers, afford all reasonable, proper, and equal facilities for the interchange of traffic between their respective lines, and for the receiving, forwarding, and delivery of passengers and property to and from their several lines and those connecting therewith, and shall not discriminate in their rates and charges between such connecting lines; but this act shall not be construed as requiring any such common carrier to give the use of its tracks or terminal facilities to another carrier engaged in like business."

Making due allowance for the conditions to which the qualifying clause cited above is applicable, and for a few comparatively short roads which are isolated, all the American railways may be said, in an important sense, to be practically one system for the transportation of persons and property between all sections of the United States, and its efficiency is increased by the fact that it is composed of many minor systems, varying in the length of lines they operate and control from a few hundred to more than seven thousand miles, each of which has powerful business incentives for the performance of its portion of a joint task in the best possible manner.

The annual report of the interstate-commerce commission, dated December 1st, 1887, says: "The railroad mileage of the United States, computed to the close of the fiscal year 1886, of the companies respectively, was 133,606. The number of corporations represented in this mileage was 1,425, but by the consolidation or leasing of roads the number of corporations controlling and operating roads as carriers was reduced to 700. It is estimated that 4,380 miles of road have been constructed since the foregoing statistics were obtained, making a total mileage at this time of 137,986. It is impossible to say with entire accuracy what is the number of railroad companies subject to the provisions of the act, but it is believed that not less than 1,200, operated by about 500 corporations as carriers, engage either regularly or at times in interstate commerce, so as to make the act applicable."

In the early months of 1888 the length of main line of American railways presumably consisted of an aggregate of about 150,000 miles; and although there were then perhaps from 500 to 700 companies engaged in conducting interstate transportation, a considerable number of these were controlled by central authorities of large systems, so that the number of systems was much smaller than the number of operating companies. Each of the large systems, in turn, formed one of a group of systems, and these groups, combined, formed an entire system.

There is a considerable variation in the closeness of the ties by which all parts of the different railway systems are united. In some instances they are only linked together by the tie of common interest or mutually advantageous traffic arrangements. In others ownership of stock gives the central company a controlling power. In others the bond of union is based chiefly on the fact that a given set of individuals own or control a majority interest in all the leading lines. In some cases the principal company gains control of the roads in its system by a variety of methods, holding some lines because their owners do not wish to operate them, and other roads by leases or ownership of a majority of stock. These and other variations naturally result in occasional changes in the position of some roads, which may belong to one system in one year and to another in the succeeding year, or be severed from old close connections by expiration of lease, bankruptcy, or other causes, and subsequently aim at establishing a new independent system. The general tendency throughout all these changes is towards the expansion or increase of the mileage of all the important systems after they are once fairly established, but in a few instances the opposite tendency has prevailed.

Accurate data relating to the exact length of the lines connected with all the various systems at any given period has heretofore been unattainable, but enough is known to show that a considerable number of systems contain more than a thousand miles of road, some more than two thousand miles, some more than three thousand miles, some more than four thousand miles, some more than five thousand miles, and a few, including the Pennsylvania, Missouri Pacific, and Atchison, Topeka and Santa Fe, more than seven thousand miles.

The tendency towards consolidations, and an increase of the length of systems either by leases, purchase of a controlling interest, or new construction, was more stubbornly resisted in New England than in any other section; but even in that quarter considerable additions have recently been made to the length of old systems, and in all other quarters there have been few serious obstacles to notable expansions.

The magnitude of the operations of various systems in 1879–80 and a few years later has already been indicated by statements compiled from the census report on railways and other sources, which showed that in 1879–80 forty-four corporations conducted 80.4 per cent. of the whole freight traffic and nearly 60 per cent. of the railway passenger business of the country, and that in 1881 more than 47 per cent. of the railway freight receipts were earned by thirteen systems. Subsequently the tendencies towards such concentrations rather increased than diminished, the length of the mileage controlled by nearly all the large systems of 1880–81 and the volume of their transactions being materially increased; and some systems which were formerly of inconsiderable magnitude were expanded with wonderful rapidity. Prominent instances of the last-named class are the Richmond and West Point Terminal, and the Atchison, Topeka and Santa Fe systems.

The boundaries of the various groups are partially indicated by the lists of companies belonging to the respective railway confederations heretofore published. The important systems of each group or class of roads, compete with each other for the through traffic they obtain, the systems of each group competing for the largest attainable share of the systems in each connecting group, and often for much of the traffic they move over comparatively short distances.

The result is to secure for the main body of the American people, and all their diversified interests, a perpetual contest between giant systems for the privilege of hauling persons and all descriptions of movable property, between all distant portions of the Union, and between many stations in comparatively close proximity. Whether men wish to travel or trade between the Atlantic and Pacific, or lake and gulf ports, or between many thousands of intermediate places, rival rail carriers are always ready and anxious to serve them, always for a remuneration which falls below old rail or water standards, and often for exceedingly low rates or fares.

RELATIVE RANK OF RAIL AND WATER CARRIERS.

IT has heretofore been shown that in the progress of the development of the transportation systems of the United States a leading feature of the starting point was the manifest impossibility of economically moving bulky freight over considerable distances by land routes. Water channels only were available for such purposes, and they continued to furnish the principal reliance up to about the middle of the nineteenth century. After 1850, however, rail routes began to rise rapidly in relative importance with the swift progress of new construction, and since that period there has scarcely been a serious interruption of this movement. It is a natural result of the large additions to railway mileage, and the possibility of extending railways everywhere, while the length of water routes has not been materially increased, and cannot be, except by enormous expenditures; of great reductions in railway rates, and increase of the number and capacity of freight cars; of the steady continuance of railway operations at all seasons, except when they are briefly suspended by extraordinary blizzards or unusual calamities, while the interior water channels of northern latitudes are closed during winter months, and low water is often an obstacle to movements on some of the southern rivers; and of numerous improvements in railway appliances for passenger travel, which have greatly increased speed, comfort, and assurances of safety.

Generally speaking, in other countries an inflexible governmental policy has been pursued in regard to financial outlays for railways or artificial water-ways, all classes or none receiving aid from public treasuries, while in the United States many systems have been tried at various epochs and different places, partly on account of numerous changes and diversities in the condition of various localities. Out of numerous experiments a strong tendency was developed to place railways squarely on the footing of commercial enterprises, in which their owners and creditors might make or lose money without affecting the finances of any class of governments, and to subject them to an increasing number of legal restrictions and antagonisms, while another set of aids to transportation efficiency, consisting of improvements of water-ways, road bridges, and ordinary highways, were to an increasing extent provided for solely by governmental outlays, some of which have been materially increased during recent years.

Much has been said of the importance and magnitude of water systems of transportation, conducted on canals, the great oceanic, lake, and gulf boundaries of the Republic, and the navigable portions of its rivers. Appropriate measures for their improvement are commendable. But the aggregate length of such routes forms a small percentage of the existing railway mileage, and one of the notable features of modern railway development is the remarkable extent to which it has aimed at paralleling water lines, and supplementing or partially supplanting the water carriers who formerly monopolized important classes of traffic of which a large percentage is now conducted over rail routes. There is scarcely an American navigable river, canal, or coast line, at the present day, which is not closely paralleled by one or more railways, which compete with the carriers who use the adjacent water channels, and one of the features of the new construction since 1880 is a material increase of such rail competition, especially on the borders of the northern lakes, the Mississippi, the gulf of Mexico, and the Pacific coast.

It seems paradoxical to assert that a considerable percentage of the internal commerce of the country is conducted on external channels, but this is the fact, for, aside from the Canadian railway lines which move freight between American cities, through their control of, or alliances with, connections in the United States, many coast-wise movements of notable magnitude, between American ports, are made in American vessels on the northern lakes, the Atlantic, the gulf of Mexico, and the Pacific coast.

It would be difficult, if not impossible, to obtain reliable data relating to the proportion that freight movements on all these great natural water channels bear to the entire freight movement of the country. There is no doubt of the magnitude of the shipments over water routes, but in the aggregate they fall far below the total quantity moved by rail. The Chief of the Bureau of Statistics, in his first report on internal commerce, published in 1877, estimated the value of the commodities transported on rail at $18,000,000,000, and said that "the value of our internal commerce is about sixteen times the value of our foreign commerce." He added that "if it were possible to ascertain the value of the commerce between the different sections of the country, on the ocean and gulf, and on the lakes, rivers, and other avenues of transportation, we should probably find that the total value of our internal commerce is at least twenty-five times greater than the value of our foreign commerce." This estimate appears to be to the effect that about $\frac{16}{25}$ or nearly two-thirds of the internal commerce of the country was conducted on railways in 1876 or 1876–77. The proportion has presumably been materially increased since that period.

Positive data relating to various interior water routes clearly shows that on them rail movements have relatively been rapidly advancing, during recent years, every important class of rail traffic showing large gains, while the magnitude of some of the interior water route movements has been diminished.

A considerable amount of information bearing on the movements on the Mississippi and its tributaries, during recent years, is furnished in a report on the commerce of the Mississippi and Ohio rivers, submitted by the Chief of the Bureau of Statistics to the Treasury Department of the United States on January 30th, 1888, and published as a Government document. From it the following statistics are compiled:—

OHIO RIVER TRADE.

A detailed estimate of the value of commerce conducted, by river, at all the cities, towns, and principal landings of the Ohio, in 1869 and 1886, shows that in the former year it was valued at $591,754,000, and in the latter year at $253,481,783, a decline of more than one-half. At a few towns there were special causes for the diversion or diminution of trade or production, but it is stated that "the apparent decline of river traffic at various points is not indicative of commercial decay of such communities. The almost omnipresent rail competition is an element in the count that brings up commercial footings to several times more than the totals of water transportation for all points where the two run counter to each other."

The number of boats and tonnage registered at Ohio river ports for the year 1886 was reported to be as follows: Passenger steamers, 158, with a tonnage of 47,924.13; tow-boats, 188, with a tonnage of 34,946.56; saw-mill boats, 9, with a tonnage of 509.78; excursion and ferry boats, 50, with a tonnage of 6,230.52; total, 405, with a tonnage of 89,610.99.

MOVEMENTS ON THE MISSISSIPPI.

A number of details are published of the commerce of St. Louis, and the relative extent of rail and river transportation to and from that city, during a considerable period. Its river traffic includes movements on the Upper Mississippi, the Lower Mississippi, the Illinois, the Missouri, the Ohio, the Cumberland, and Tennessee, so that it represents a large percentage of the trade of the greatest of interior river systems. St. Louis is, on the other hand, one of the most important of the interior railway centres, and much has been done during late years to increase the importance of its railway connections. The results are shown in a series of tables. The number of tons of freight received and shipped in 1871 was 4,913,102, of which 1,654,899 tons, or 33.68 per cent., was moved by river, and 4,913,102 tons, or 66.22 per cent., was moved by rail. In 1887 the total number of tons moved was 14,359,059, of which the number of tons moved by river was 1,503,105, or 10.46 per cent., and the rail movement was 12,359,059 tons, or 89.53 per cent. The tendency towards an increase of the relative magnitude of the rail movement, from year to year, was comparatively slow but uninterrupted, except from 1879 to 1880, from 1885 to 1886, and from 1886 to 1887. The lowest period reached in quantity and relative rank of river movements was in 1885, when the number of tons moved by river was 1,013,240, or 8.81 per cent.

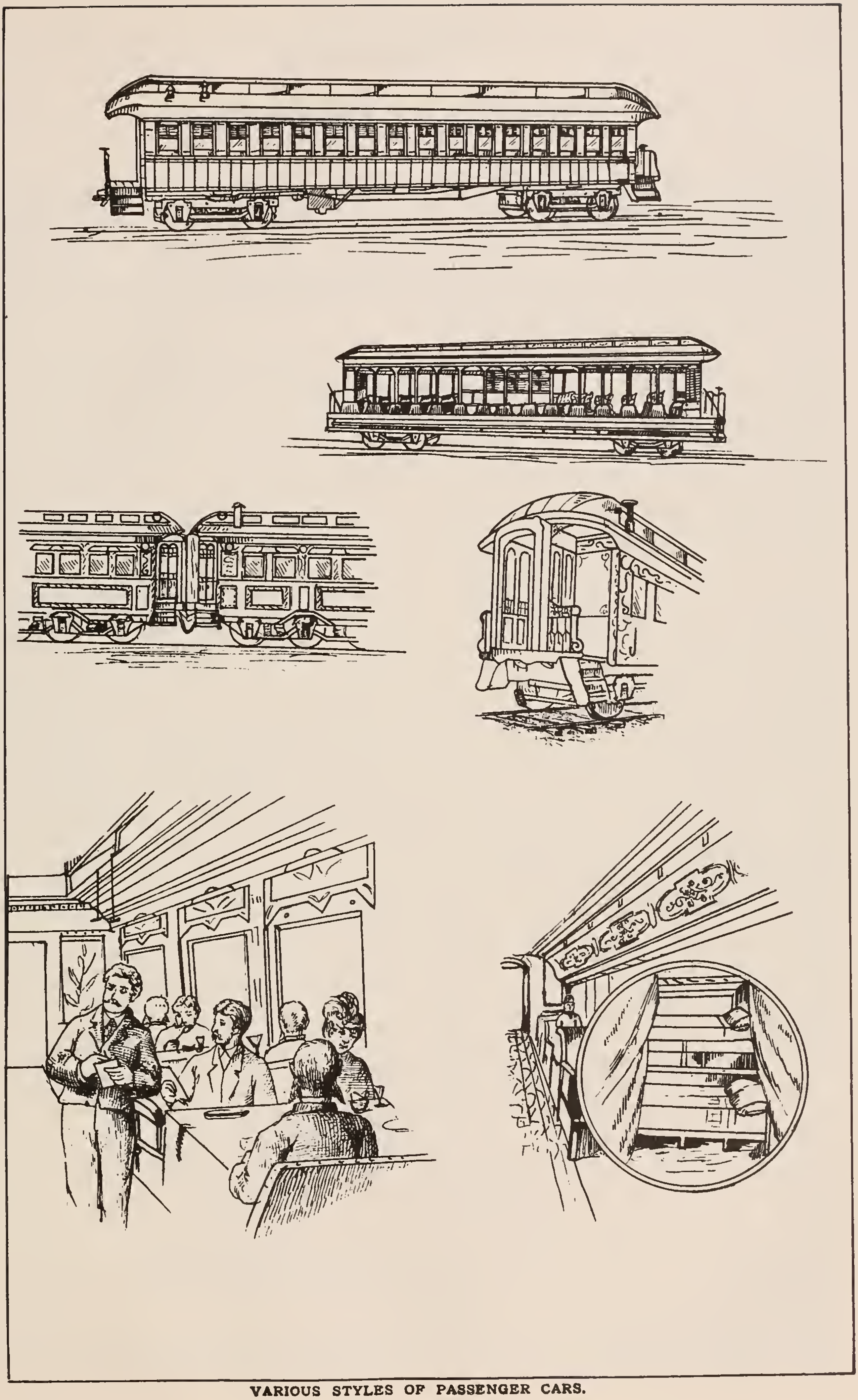
Statements of the St. Louis receipts and shipments by various rivers during each month of 1887 show the following aggregates: From the Upper Mississippi 132,400 tons, exclusive of 213,165 tons forwarded by raft, were received, and 36,170 tons shipped. From the Lower Mississippi 268,735 tons were received, and 538,065 tons shipped. The traffic on the other rivers was as follows: Illinois river—receipts, 78,560 tons; shipments, 7,125; Missouri river—receipts, 27,700; shipments, 14,580; Ohio river—receipts, 121,670; shipments, 19,035; Cumberland and Tennessee rivers—receipts, 23,815; shipments, 18,715; Red and Ouachita rivers—shipments, 3,370 tons.

At New Orleans changes similar to those reported at St. Louis have occurred. A table showing the value of receipts, partly estimated, in each commercial year from 1872–73 to 1886–87, shows that in 1872–73 such receipts were valued at $184,620,047, of which $144,168,477 were forwarded by river, and $44,452,477 by rail and canal. In 1886–87 the estimated value of receipts was $164,028,664, of which $59,326,765 was forwarded by river, and $104,901,899 by rail and canal.

The following extracts from an interesting and instructive article on the "Commerce of the Mississippi River from Memphis to the Gulf of Mexico," which forms part of the report of the Chief of the Bureau of Statistics of 1888, illustrate the modern tendencies: "There has been a material decline in the river business of the Lower Mississippi during the last five years. This has been more in value than in tonnage. During this period there has been a falling off in the shipment of the more valuable products and an increase in the handling of heavy articles. The barge and floating tonnage has grown; the steamboat tonnage declined." A table of river receipts (not including rafts) and shipments in each year from 1880 to 1887 shows that in 1880 they consisted of 2,959,250 tons, and in 1887 of 2,473,072 tons. It is stated that "during the period the receipts by river at New Orleans show a falling off of 9 per cent., and in the shipments up stream of 23 per cent. The decline varies greatly in the different lists of articles handled and received. There have been heavy losses in the provision trade and in cotton by river. Sugar and rice show a decline; that is a larger proportion of the crop is brought to market by the railroads than formerly. Grain and breadstuffs have been fluctuating, dependent upon the railroad and ocean freight rates. On the other hand, there has been a large increase in the receipts of coal and coke, stoves, lumber, and bulky articles." Detailed references are made to the specific effect of various railways and railway systems. It is stated that "of the seven lines centreing in New Orleans all compete with the river route. The New Orleans and North-eastern is the least affected by this competition, although it is an air line from New Orleans to another river point, Cincinnati. . . . The railroad business has steadily advanced since the war, and its advance has been largely at the expense of the steamboats. . . . The advance has been steady and without a single set-back. In fourteen years the railroads have quadrupled their business, in six years doubled it."

INCREASE OF THE MAGNITUDE OF RAILWAY LABORS.

While the amount of domestic traffic conducted on water channels has declined in some respects and increased in others, since 1880, important fluctuations from year to year being not uncommon, the growth of the business of many companies and of the entire railway system has been rapid. Detailed statistics in Poor's Manual show that the aggregate advance from 1882 to 1886 on all the railways of the United States was as follows: The number of passengers carried increased from 289,030,783 to 382,284,972. The passenger movement increased from 7,483,059,934 to 9,659,698,294. The number of tons of freight moved increased from 360,490,375 to 482,245,254. The freight movement increased from 39,302,209,245 to 52,802,070,529. The unfavorable influence of the period of depression, which diminished new construction, however, is reflected in the small gain in the volume of freight movements from 1883 to 1884. There was a slight decrease in the number of tons moved, and the advance in the freight movement was much below the average standard, as it was only from 44,064,923,445 to 44,725,207,677.



VARIOUS STYLES OF PASSENGER CARS.

PERSONNEL OF RAILWAYS.

BRIEF references have been made to a few of the prominent individuals who rendered special services in connection with the establishment of some of the features of the transportation systems of this country. A complete record of the labors of all who were actively and usefully engaged in promoting great works of internal improvement would fill bulky volumes. Without attempting such a task it seems desirable that something should be said in reference to the classes of men whose aid was necessary.

First of all come the projectors who prepare public sentiment and aid in securing essential legislation or legal authority and pecuniary support. At the outset the initial movements either originated with, or were earnestly seconded by leading men of the country and of each particular section. The newspaper press rendered invaluable and often unrequited aid in securing effective consideration for bright conceptions. An immense amount of matter was written and printed and innumerable public meetings were held before decisive steps could be taken for the construction of many of the railways of this country. As legislative action was originally essential, and as nearly all the important early works were aided directly or indirectly by governmental authorities, internal improvement questions have at various periods entered freely into politics. Although parties have occasionally divided on a few of the issues raised, most of the disputes have related to details about which members of each of the leading organizations differed. Influential politicians have at many stages been in a position to materially aid some corporations and to injure others, and a recognition of this fact has often necessitated harmonious relations between partisan and corporate interests. Much has been said at various periods of attempts of companies to unduly influence legislation and legislators. There has probably been less ground for serious accusations of this kind in the United States, in proportion to mileage, than elsewhere. But even if this supposition is correct, emergencies may have arisen in which there were reasons for believing that the prosperity of important enterprises required the friendly action of representatives of the people at any price; and practical action may sometimes have corresponded with this conclusion.

It is a misfortune to any great industrial interest to be in a position in which its revenues depend, to a considerable extent, upon the action of governments, and the most serious difficulties of a number of railways have arisen from such involvements. Laws of some kind, affecting their acquisition of a right of way, issue of securities to represent capital employed, relations with shippers and travelers, and various other subjects, must be passed, and this necessity of legislation has often been made a pretext for the agitation of measures which would cripple corporations without benefiting the public.

Mainly for the reasons thus briefly stated, and formerly for more cogent ones, arising from the frequency with which governmental advances of lands, money, or bonds were at some periods made to railway companies, councilmen, mayors, legislators, governors, congressmen, senators, and presidents have at various periods exerted an important influence for or against particular enterprises, and before the existing agencies of transportation could assume their present shape it was necessary that many a sturdy battle should be fought and won in council chambers and capitols.

Either before or after legal obstacles are overcome the services of civil engineers must be procured, and on their wisdom and integrity so much depends that they can often make or mar the fortunes of a difficult undertaking. Terrible disasters and brilliant successes can each be traced to their decisions and influence.

When canal construction first commenced the native supply of trained civil engineers was so limited that it was considered necessary to send to Europe for an expert; but home recruits were soon found, at first among men trained as land surveyors, and subsequently among the assistants of engineers of recognized capacity, or graduates of home or foreign schools, including a number of military officers who had been trained at West Point. From small beginnings, there was a rapid expansion in many directions, and after lines were finished, and enormous additions to mileage and traffic were made, there was a corresponding enlargement of the operating forces.

In the progress of railway development one of the most important changes was a great increase in the number of men employed, and in the extent to which a division of labor and diversification of talent and effort became necessary. Other concomitants were steps to devise or improve systems of organizing the forces of assistants, the arrangement of details relating to the general rules by which each class should be governed, the increasing extent to which employés devoted special or exclusive attention to particular tasks, and the formation of various organizations of men engaged in sundry branches, some being intended to promote the efficiency of methods of conducting transportation operations, while others were used chiefly to advance the real or supposed personal interests of their members.

The average number of railway employés of all grades, in 1880, as stated in the census report, was 418,957, but a correction in a foot note reduces it to 415,967. In that year the mileage operated was 87,782, and there was an average of little less than five employés per mile of road operated. This average has since been materially increased, but if a corresponding ratio has been maintained, in the entire country, the average number of persons now employed (1888) is presumably from 700,000 to 750,000. This estimate is exclusive of the men employed in new construction, and in manufacturing things used by railway companies, that are not made in railway shops, including iron and other metals and materials, steel rails, locomotives, cars, car wheels, springs, &c. If both these classes were added, the total in busy years would probably be about double the average number of persons annually employed in the operation of railways, or not far from one million and a half. A recent estimate places the number at about two millions. In the matter of furnishing employment railways rank second only to agriculture, and greatly exceed all other interests.

The forces directly employed by railway companies in 1880 were classified as follows: General officers, 3,375; general office clerks, 8,655; stationmen, 63,380; trainmen—engineers, 18,977; conductors, 12,419; all others, 48,254; total, 79,650; shopmen—machinists, 22,766; carpenters, 23,302; all others, 43,746; total, 89,714; trackmen, 122,489; all other employés, 51,694; aggregate, 418,957. The aggregate amount of the pay rolls was $195,350,013, which gave an average of $16,279,168 per month, or about $39 per month for each employé, including all classes.

The companies which in 1880 reported that they employed in railway service one thousand or more persons were as follows:—

In New England.—Boston and Albany, 4,656; Boston and Lowell, 1,107; Boston and Maine, 1,526; Central Vermont, 2,013; Eastern, of Massachusetts, 2,080; Fitchburg, 1,562; Maine Central, 1,000; New York and New England, 1,870; New York, New Haven and Hartford, 2,270; Old Colony, 2,120.

In group II, consisting of New York, Pennsylvania, Ohio, Michigan, Indiana, Maryland, Delaware, New Jersey, and District of Columbia.—Allegheny Valley, 1,511; Albany and Susquehanna, 1,500; Baltimore and Ohio, 14,619; Central of New Jersey, 5,998; Chicago and Grand Trunk, 1,238; Cincinnati, Hamilton and Dayton, 1,056; Cincinnati, Indianapolis, St. Louis and Chicago, 1,227; Cleveland, Columbus, Cincinnati and Indianapolis, 3,122; Cleveland and Pittsburgh, 1,696; Columbus, Chicago and Indiana Central, 3,430; Delaware, Lackawanna and Western, 7,218; Flint and Pere Marquette, 1,008; Grand Rapids and Indiana, 1,124; Lake Shore and Michigan Southern, 9,203; Lehigh Valley, 5,517; Long Island, 1,877; Manhattan, 2,982; Marietta and Cincinnati, 1,927; Michigan Central, 5,052; New York Central and Hudson River, 13,164; New York, Lake Erie and Western, 13,687; New York, Pennsylvania and Ohio, 4,410; Northern Central, 2,275; Ohio and Mississippi, 3,400; Pennsylvania, 26,397; Pennsylvania and New York Canal and Railroad Company, 1,000; Philadelphia and Reading, 11,381; Philadelphia, Wilmington and Baltimore, 2,180; Pittsburgh, Cincinnati and St. Louis, 2,619; Pittsburgh, Fort Wayne and Chicago, 7,959; Rensselaer and Saratoga, 1,416; Rome, Watertown and Ogdensburgh, 1,346; Terre Haute and Indianapolis, 1,360.

In group III, embracing Virginia, West Virginia, Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, and South Carolina.—Atlantic, Mississippi and Ohio (now part of the Norfolk and Western), 1,289; Central of Georgia, 1,537; Chesapeake and Ohio, 2,687; Chicago, St. Louis and New Orleans, 2,564; Louisville and Nashville, 4,277; Memphis and Charleston, 1,036; Mobile and Ohio, 1,665; Nashville, Chattanooga and St. Louis, 2,083; Richmond and Danville, 1,081; South Carolina, 1,250; Washington City, Virginia Midland and Great Southern, 1,010.

In group IV, containing Illinois, Iowa, Wisconsin, Missouri, and Minnesota.—Burlington, Cedar Rapids and Northern, 1,345; Chicago and Alton, 3,900; Chicago, Burlington and Quincy, 12,587; Chicago, Milwaukee and St. Paul, 10,824; Chicago and Northwestern, 8,557; Chicago, Rock Island and Pacific, 6,930; Chicago, St. Paul, Minneapolis and Omaha, 1,106; Hannibal and St. Joseph, 1,149; Illinois Central, 4,610; Indianapolis and St. Louis, 1,469; Kansas City, St. Joseph and Council Bluffs, 1,384; Missouri, Kansas and Texas, 2,022; Missouri Pacific, 2,500; St. Louis, Iron Mountain and Southern, 3,971; St. Louis and San Francisco, 1,750; St. Louis, Vandalia and Terre Haute, 1,503; St. Paul, Minneapolis and Manitoba, 3,128; St. Paul and Sioux City, 1,045; Wabash, St. Louis and Pacific, 8,064; Winona and St. Peter, 1,418; Wisconsin Central, 1,195.

In group VI, containing Dakota, Nebraska, Kansas, Texas, New Mexico, Colorado, Wyoming, Montana, Idaho, Utah, Arizona, California, Nevada, Oregon, and Washington.—Atchison, Topeka and Santa Fe, 5,695; Burlington and Missouri River (in Nebraska), 1,326; Central Pacific, 6,317; Houston and Texas Central, 2,400; International and Great Northern, 1,181; Kansas Pacific, 2,069; Northern Pacific, 2,510; Texas and Pacific, 1,459; Union Pacific, 3,959.

Only a small proportion of the companies that reported to the census bureau employed more than 1,000 men. Ten of the companies that employed less than that number, employed more than 900. Seven companies employed between 800 and 900. Thirteen companies employed between 700 and 800. Six companies employed between 600 and 700. Twenty-four companies employed between 500 and 600. Twenty-three companies employed between 400 and 500. Forty-three companies employed between 300 and 400. Thirty-nine companies employed between 200 and 300. Eighty companies employed between 100 and 200. Three hundred and fifty-four companies employed less than 100, and a large proportion of them employed less than 50.

SYSTEMS OF RAILWAY ORGANIZATION.

IT is obvious that out of the great diversity in the number of persons employed by different railway companies, as well as other circumstances, differences have arisen in various matters relating to the organization of working forces.

ORGANIZATIONS OF SMALL ROADS.

As in the past, so in the present, there are some small roads which might have furnished the groundwork of the description of a humorous writer who credits a president with saying that he is the principal owner, and also "the board of directors, treasurer, secretary, general manager, superintendent, paymaster, track master, general passenger agent, general freight agent, master mechanic, ticket agent, conductor, brakeman, and boss. The engineer does his own firing, and runs the repair shop and round-house, all by himself."

One writer of high railway standing, H. S. Haines, in referring to this subject, says: "There are those among us whose memory goes back to the patriarchal stage of management, when most corporations owned not more than fifty or a hundred miles of track; when the treasurer sold tickets at the principal passenger station on the road, and the freight agent at the same station was virtually the head of the transportation department; when no bill was paid except upon the order of the president, and periodical reports and statistical statements were unknown." In referring to a similar stage of development, Charles Francis Adams says he can easily remember when the first railroads were organized in Massachusetts. "An apothecary was president of the Old Colony Railroad, which carried 250 passengers a week, considered something wonderful forty years ago."

ENLARGED SYSTEMS OF ORGANIZATION

were necessitated by additions to mileage and the growth of business. Thirty years ago the model management of a first-class road of that era was divided first into two grand departments. One related to financial affairs and all accounts, and was managed by the president, secretary, treasurer, attorney, and directors. The other was the operating department, with a commercial branch and a mechanical branch. They were, in turn, subdivided under the direction of a general superintendent. His principal officers were first, a superintendent of road, whose chief assistants were road masters, the employés under their direction being section men; second, a superintendent of machinery, whose chief aids were a foreman of a machine shop in which machinists worked, a foreman of a blacksmith shop and blacksmiths, a foreman of a car shop and carpenters, a foreman of a paint shop and painters, engineers (not on trains) and firemen, and car masters who directed operations of oil men and cleaners; a general passenger agent whose leading assistants were conductors and mail agents who directed the labors of brakemen, engineers (on passenger trains), and ticket agents, station agents, express agents, and police; a general freight agent whose principal assistants were conductors who directed labors of brakemen and engineers on freight trains, freight station agents, weighers, gaugers, and yard masters; a supply agent and a fuel agent, who each had appropriate assistants.

GENERAL PRINCIPLES OF ORGANIZATION.

A report made to the stockholders of the New York and Erie Railroad in 1856, by D. C. McCallum, stated that the following general principles should be observed in arranging the organization of railway forces:—

"First. A proper division of responsibilities.

Second. Sufficient power conferred to enable the same to be fully carried out, that such responsibilities may be real in their character.

Third. The means of knowing whether such responsibilities are faithfully executed.

Fourth. Great promptness in the report of all derelictions of duty, that evils may be at once corrected.

Fifth. Such information to be obtained through a system of daily reports and checks that will not embarrass principal officers nor lessen their influence with their subordinates.

Sixth. The adoption of a system, as a whole, which will not only enable the general superintendent to detect errors immediately, but also point out the delinquent.

A system of operations to be efficient and successful should be such as to give to the principal and responsible head of the running department a complete daily history of details in all their minutiæ."

Such principles have been respected, to a considerable extent, for the protection and benefit of companies, but as the magnitude of operations increased various modifications or additions were found desirable or necessary.

OF THE PRESENT LARGE RAILWAY ORGANIZATIONS

Charles Francis Adams, in addressing students of Harvard University, in March, 1886, said:—

"In the modern railroad there are five departments. First is the financial department, which is the sinew of the whole body, its ways and means; second, the construction department, of which the head is the chief engineer, who lays out the road; thirdly comes the operating department, with the superintendent at the head; fourth comes the commercial department, looked after by the general traffic manager; and, then, fifth, comes the legal department. The counsel for the company looks after all legal papers, suits, &c., and has a vast amount of business to attend to. The duties of these departments are as varied as those of the United States government, and the heads constitute a sort of cabinet, and the pivot wheel around which the whole machinery moves is the president. In the beginning of the building of railways $1,000,000 was deemed a large capital for a railroad. The capital of the Union Pacific is represented by $270,000,000 of securities of the forty or fifty roads which are combined in this general system. Its income is $25,000,000 a year, and in profitable times reaches $100,000 a day. It employs 12,000 men, and has a monthly pay-roll of $800,000; 12,000 cars are run by 550 locomotives; 25,000 tons of steel rails are used in replacing worn-out rails, and 2,000,000 ties are used in keeping the road-bed in condition. If you compare this with the United States government, the affairs of the latter during the first fifty years of its existence were trifling. Yet this is only one system, and there are five more by the side of which—for example, the Pennsylvania—the Union Pacific is insignificant. If this is the growth of forty years, what will be that of sixty or eighty years. I confess that I am unable to forecast it. This great principle of consolidation and aggregation, like the principles of gravitation, has as yet but begun to develop its results."

H. S. Haines, in discussing the same subject, says: "The experience of half a century has developed a form of organization which has been generally accepted as the pattern of efficient management. It is based upon a recognition of the several purposes which the organization is expected to fulfill. That is, first, the road which forms the line of communication, whose maintenance is in charge of the roadway department. Then there is the movement of the vehicles in which freight and passengers are carried, which service is performed by the transportation department, and the maintenance of these vehicles by the car department, and of the motors by the locomotive department, or, these two departments may be operated jointly as the machinery department. Then are the somewhat complex duties involved in soliciting and handling the business of the traffic department, which may be divided between the general freight agency and the general passenger agency. These are the principal operating departments, but the organization must also include a fiscal agency under the treasurer, a department of audit and statistics, a purchasing agency and perhaps a technical bureau, and a legal department. With a general superintendent or a general manager, assisted by division superintendents and agents, the plan here given is the recognized type of a modern railroad organization, apart from what belongs to it as a legal corporation."

GOVERNMENTAL METHODS OF CLASSIFYING RAILWAY OFFICIALS.

A Government report on Pacific railroads classifies officers of the lines aided by the United States under the following heads: President, vice-president, secretary, treasurer, general executive officer, general accounting officer. The distinctive title of the general executive officer in a majority of cases is general manager, but in some instances he is called general superintendent, in others superintendent, in others traffic manager, and in others manager. The various titles of the official designated as general accounting officer are auditor, comptroller, general auditor, and local treasurer.

The working forces are designated under the following heads: General officers, clerks in general offices, road masters, section foremen, day laborers, station agents, clerks at stations, other help at stations, conductors, other train men, yard, switch, and watchmen, master mechanics, shop foremen, mechanics, engineers, firemen, bridge carpenters, car-shop carpenters, other employés.

Under the head of station expenses reference is made to station agents, clerks, attendants, watchmen, laborers, switch-tenders, baggage masters, yard masters, train dispatchers, and telegraph operators. Under the head of maintenance of track reference is made to road masters, clerks, mechanics, laborers, and watchmen. Under the head of motive power engineers, firemen, wipers, and shop foremen are enumerated. Under the head of administration and general expenses reference is made to general officers, division superintendents, clerks, and attendants.

A proposed form of reports of employés and salaries, to be made to the interstate commission by all railway companies, gives a list, leaving blanks for such additions as may be necessary, which embraces the following titles: President, —— vice-president, —— vice-president, secretary, treasurer, chief engineer, general solicitor, assistant solicitor, comptroller, auditor, —— auditor, general manager, traffic manager, general freight agent, general passenger agent, general ticket agent, general baggage agent, general superintendent, division superintendents, road masters, assistants to executive officers. General offices: clerks; stenographers. Station agents; station agents' clerks; station agents' helpers; baggagemen, stations; baggagemen, train; conductors, passenger trains; conductors, freight trains; brakemen, passenger trains; brakemen, freight trains. engineers, passenger trains; engineers, freight trains; firemen, passenger trains; firemen, freight trains; train dispatchers; operators; mechanics, state various classes; laborers, state various classes.

A detailed list of the classes of officers and operatives of railway companies contains 334 names, by which they are designated. It embraces distinctive titles for different classes of agents, clerks, conductors, foremen, inspectors, porters, superintendents, watchmen, &c.

GENERAL CHARACTERISTICS OF MODERN RAILWAY ORGANIZATIONS.

The lists of leading officials of various large roads show that there are sundry variations in the titles given to some classes of officers, and detailed statements would presumably furnish evidence of differences in a number of particulars, including the extent to which companies have found it desirable to employ important officers and large clerical forces for the performance of special duties, such as keeping track of car movements, tickets, &c. Some of the western roads have large land departments, for which there is no equivalent on eastern lines. Some of the latter, in turn, have large interests in coal lands or valuable real estate they do not intend to sell, which require the supervision of important officials.

There are sundry changes made from time to time in organizations. One of the modern tendencies is to increase the number of vice-presidents, so that such officers may be placed in special charge of one or more of the grand divisions of railway labor. Such changes have doubtless been desirable, in a number of cases, for the purpose of relieving the presidents of companies, and their principal assistants, from a portion of the arduous labors and heavy responsibilities thrust upon them. It is almost inevitable that presidents of important roads should be overworked if they are deeply impressed with a desire to fully perform their allotted tasks, and if they endeavor to keep a close supervision over all departments. As the heads of companies they usually have greater freedom of choice in regard to the range of their actual labors, from day to day, than other officials. They are frequently able and industrious men. They may do too much, by exercising such jealous scrutiny that heads of departments have not sufficient freedom to secure the best results, or they may do too little.

No general description of the various railway departments would be fully applicable in all respects to all lines. A sketch published in the Louisville Courier-Journal approximately represents the prevailing methods. It says that the departments are "the accounting, sometimes presided over by a comptroller, who may report either to the general manager or the president; the traffic department, which may have for its head a traffic manager, assisted by general freight agents and general passenger agents; the operating, in charge of a general superintendent. The accounting department is the one in which all accounts are kept, and the auditor, who usually assists the comptroller, is responsible to the general manager, who receives an impression copy of each 'way bill,' which shows the name of the shipper, the point of shipment, the name of consignee, the destination, the marks, and the weight and freight charges on each consignment carried over the road. This way bill he scrutinizes carefully, and sees that the charges are in accordance with the rates announced by the general freight agent. If they are found correct he makes from them numerous records, crediting agents or connecting railroads, and charging others. The ticket agents send him either daily, weekly, or monthly reports of their sales, which are checked with the tickets forwarded to him by conductors when taken up on trains.

The operating department is one of the most important on a railroad, as the success of the whole depends on its efficiency. The general superintendent is assisted by a superintendent of roadway, a superintendent of machinery, and a superintendent of transportation. The superintendent of roadway has charge of all tracks, and usually all bridges and buildings pertaining to the track department; although some roads provide a separate officer who looks after bridges alone. The superintendent of roadway is assisted by road masters who have charge of divisions, varying according to physical features of the track. These road masters direct all work performed on their divisions by section foremen and track men. The superintendent of machinery has charge of all locomotives and is responsible for the performance of proper service. He also has charge of enginemen, firemen, and machinists.

The superintendent of transportation has charge of the movement of trains over the line, appoints conductors, brakemen, agents, and train dispatchers, distributes cars where they are needed, and is generally responsible for the safe and speedy movement of passengers and freight. He is assisted by train masters, whose duties vary on many lines, but they are generally immediately under the direction of the superintendent of transportation.

The traffic department is really the commercial department. It is divided between a general freight agent and a general passenger agent, both of whom report to and receive their instructions from a traffic manager, or, where there is no traffic manager, from the general manager. The general freight agent has charge of the fixing of rates for transportation of freight, and under his supervision soliciting agents and traveling agents watch the movement of traffic, and secure to the road such of it as can be controlled. All reclamations for loss, damage, or overcharge on freight while in transit are adjudged by him.

The general passenger agent supervises the passenger traffic in the same manner that the general freight agent provides for the freight business, it being his duty to see that his railroad is properly and sufficiently advertised; that it is represented impartially in the ticket offices of all connecting lines, and to supervise the printing and supplying of such tickets to the agents of his line as the needs of his patrons demand These officers of the freight and passenger departments have their hands full, as do all others in charge of departments.

There is a chief clerk who is supposed to do a little of everything from answering the telephone to discussing a knotty problem of policy toward some refractory competitor or connection with his superior, so as to carry out that gentleman's ideas.

As a rule the heads of departments are young men, and the demands on the brains and strength of these officers are so severe that they seldom die in the service from old age. They are well though not extravagantly paid, the salary varying according to the size of the road. The clerks in the departments are usually men of ability, and are generally well informed. Each is fitted by natural talents, experience, and education for some particular kind of work, and is not supposed to know much of the duties performed by other men."

RAILWAY PRESIDENTS.

VARIATIONS in the scope of the labors actually performed by the railway presidents of the United States have been accompanied with and perhaps partly caused by noticeable differences in their individual characters, acquirements, and antecedents. Generally speaking, in recent years, the tendency has been strongly towards a requirement that they should possess an extensive railway experience. In different instances it was acquired in various branches of railway affairs, the preliminary labors being either in legal, financial, engineering, constructing, or operating departments. A considerable number of presidents have been chosen chiefly on account of the favorable influence they could presumably exercise either in commercial, banking, or investing circles, with little regard to their actual knowledge of the complicated details of railway movements. Others have virtually elected themselves by their control of stock or influence with stockholders. Others have been selected as presidents solely on account of skill displayed in the management of one or more branches of practical railway affairs, and possession of recognized executive ability.

The office is one of great importance, and the stockholders of different companies have acted in some instances on the theory that they neither desired nor expected the president to be the active head of all departments, looking to him chiefly as a financial leader, while in other cases presidents have been chosen in the expectation that they would exercise intelligent supervision over all classes of operations. In the one case, the instincts of a thoroughly trained railroad man are likely to exercise a controlling influence, and in the other, such predominance is not equally probable. Good and bad results have been attained under the administration of presidents with each important class of antecedents. But extensive experience has strengthened the belief that the chances of success are improved by the selection of men who possess in a high degree recognized forms of railway ability and experience. Shrewd observers, noted for their familiarity with the inside workings of railway organizations, think the practical course pursued by presidents is often influenced greatly by their antecedent training, sometimes to an injurious extent, and that this is one of the tendencies that should be guarded against by boards of directors or other influences. This theory is to the effect that the special training in financial, engineering, or operating departments may create a proclivity to display too great an interest in the department of which most is known, and too little in other departments.

Whatever the antecedent training or acquirements of a railway president may be, he can usually, if he chooses, exercise a positive influence over all the affairs of his own company, and materially affect sundry other companies with which it connects or competes, so that his characteristics may be a matter of considerable consequence. For these and other reasons there is, perhaps, no single class of men who have left a deeper impress upon the transportation systems of the United States than railway presidents. Their personal convictions, exertions, alliances, and antagonisms have exerted an important influence in creating the existing condition of affairs.

Like other rulers they have differed in conceptions of duty.

One of the most important of such differences is the extent to which freedom of action by their principal assistants in comparatively trivial affairs is permitted. The division superintendent of an important railway was invited by the corresponding official on a connecting line to visit him and pass over a portion of the road under his superintendence for the purpose of comparing views in regard to sundry roadway improvements. The reply was: "I will be glad to do so, if the president of the road will grant me permission." Then this colloquy occurred: "Must you ask him?" "Certainly; I would incur risk of dismissal if I did not. Wouldn't you have to get permission to go over my line with me?" "Gracious, no, my only danger would come from asking my president for it; he would think that if I hadn't sense enough to decide such a matter for myself, it might soon be necessary to look out for my successor." This incident illustrates differences in systems of management, the leading idea in one case being to give ample freedom in details to subordinates, but to hold them strictly responsible for results; while in the other case the weight of responsibility is substantially thrust upon the president, as his explicit permission is required for trifling, as well as important innovations, and a large portion of his time is consumed in attempts to decide sundry questions which he can scarcely be expected to understand as well as some of his subordinates.

Extraordinary emergencies occasionally arise in railway affairs which can best be met by wise and efficient action on the part of the president, and some of the most creditable and remarkable of the labors of such officials have been in connection with such exigencies, on account of their possession of great executive talent. If it is combined with power to reach wise conclusions, or ability to obtain such information and advice as are useful aids in forming a correct judgment, on critical or doubtful questions, the results are usually satisfactory.

It is supposed, in some quarters, that the general workings of American railway organizations centralize power to too great an extent. H. S. Haines, in discussing this subject, says: "The tendency is toward the concentration of authority in one man. The effect is a sort of congestion at the periphery, of which he is the centre. Everything in the direction of progress and reform must be initiated by the head of the management. The motion in that direction is not uniform; it is spasmodic. Men ordinarily move in grooves—in the line of least resistance. Perhaps it is as well that they do. Those who have to manage them have only to prepare the grooves, and they can then know where to find those whose duty it is to move in them. But there may be too much of this. It is not well for all but one man in an organization to be kept in grooves. It is not well for the heads of departments to be confined to registering and executing the edicts of the responsible manager of the railroad property. If this course be pursued, then the official head will be taxed beyond his individual capacity, and the machine will not be at its maximum state of efficiency. . . . The principal part which the head of a great system should retain for himself is not the originating of ideas nor the institution of reforms, but the co-ordination of the efforts of those who are responsible to him, so that 'all may be parts of one resplendent whole.'"

These remarks were made in connection with the advocacy of an advisory board to the general manager, providing for a free expression of the views of minor officials, but they may also be applicable, in some instances, to presidents when they are the real heads of great systems. Whatever may be the nature of the details of organization, the central power should not be overburdened with routine daily labors, and all concerned should heed the warnings given by premature deaths of prominent overworked railway officials. The machine should be so arranged that, like the government of the United States, it would be capable of running itself during the temporary absence of any of its managers.

Leading traits of distinguished dead railway presidents are briefly described in the following extracts from sketches of their careers:—

Of John W. Garrett it was said that "the principles which he laid down for the management of the road were strict economy in the working of the line, no sinecures, close attention to the purchasing department, intelligence and invention in the machinery, prompt payments to all having transactions with the company, and, in short, a practical transfer of the system of a merchant's counting room to the office of the railway president. He resolved to examine every subject and account in person."

Of William H. Vanderbilt it was reported that one of his striking characteristics "was his willingness to receive candid opinions from his advisers. He often said that he had the greatest difficulty in obtaining the views of his friends and business associates, many of whom followed the policy of watching him closely to see if they could catch from the expression of his face the drift of his mind, and then would go with it. He would often say, 'I know perfectly well that I have not got all the knowledge needed in deciding many important questions, and even when I have it, my judgment is not infallible. I know that I don't like to be crossed, and that sometimes I am irritable—I can't help that—but when I ask a man for his opinion I want it, and not what he thinks will coincide with my views.'"

One of the sketches of Commodore Vanderbilt stated that his policy in reference "to his railroad property was: 1. To get full control of the road. 2. Improve it in every possible way, and put it under first-class management. 3. Make it a paying institution."

Sketches of Thomas A. Scott deservedly give him great credit for extraordinary executive ability, and one writer states that his "peculiar strength in all emergencies lay in the rapidity with which he reached a conclusion. Hardly would a case be stated but his reply was ready, and so accurate was his judgment and intuitive his perception that he rarely erred. Work thus became easy to him, and problems that perplexed others were as playthings to his trained powers. He thus transacted an almost incredible amount of business with perfect ease, and when worn out he had the rare faculty of dropping asleep instantly and snatching the needed rest with the minimum loss of time."

An appreciative sketch of J. Edgar Thomson says that noticeable traits in his "character were reticence and taciturnity. Devoting all his life and his great natural abilities to the cultivation of one set of ideas, his accumulation of professional information was enormous. This vast knowledge made him exceedingly cautious and careful,—conservative in his ideas and generally slow to execute. But when his conclusions were reached, and the emergency required it, he became grandly enterprising, and permitted no obstacle to stand in the way of success. His thoughts and opinions were rarely made known, while he displayed infinite patience in listening to the views, desires, hopes, fears, and plans of others. Actions spoke for him —not words. He absorbed the knowledge of others, weighed, considered, and digested it thoroughly, and reached conclusions by cool, methodical reasoning. When convinced, he knew no hesitancy or doubt. The determination was as fixed as the laws of nature, and success appeared to come as a result of his faith. His conception of the future of American railroads seems now almost supernatural. For twenty years he marked out and reiterated in his annual reports the plan of the Pennsylvania Railroad Company, and he never deviated from that plan,—pursuing it persistently, patiently, and faithfully, until it was fully accomplished."

GENERAL OFFICE LABORS.

BOARDS OF DIRECTORS.

EVERY railway company has a board of directors or a board of managers. The latter title is adopted in few instances. It perhaps represents more correctly than the former the functions theoretically exercised, as they include action on every important new proceeding; the declaration of dividends; the issue of new securities; either the appointment of important officials, including the president, or the ratification of important appointments made by the president or other high officials; the construction of new lines, or other works of consequence. Their nominal position is somewhat analogous to that of a legislative body of a political government, as they are always elected by the shareholders, and are supposed to act as their immediate representatives, while the work of the railway is performed or supervised by officials and employés of many grades. The extent to which boards of directors or managers do manage railway operations or control the policy and movements of great lines, varies materially. The actual state of affairs differs widely in different companies. In some quarters there has been a strong tendency to dwarf the real powers and diminish the actual labors of directors, while in other instances the opposite tendency has prevailed. Much depends upon the character of the men who hold the respective positions, and the extent to which they are interested, pecuniarily or otherwise, in the enormous labors performed and intricate questions demanding solution. Developments from time to time show that there are some boards of directors powerful enough to enforce a change of presidents and other officials, and that, on the other hand, there are some presidents who can make important changes in their boards when they wish to do so. The real ruling power is in the hands of those who control the majority of the stock at the annual elections, and such control usually carries with it ability to determine questions relating to the quarters in which authority is vested. Struggles involving vital issues on this subject are not common, but they are sufficiently numerous to admonish all concerned of the possibility of other contests, and to remind shareholders of their possession of legal rights which are sometimes not wisely exercised. It is generally considered desirable by the parties deeply interested in the affairs of each company, of all shades of opinion on particular issues, to avoid acrimonious public contests, and for this and other reasons railway elections usually, but not invariably, result in "the re-election of the old board" until the death of one or more of its members necessitates a change.

The great magnitude of some of the existing railway systems has rendered it impossible that the members of boards could be personally and continuously familiar with the districts traversed, and in a number of cases the residences of a large proportion of directors of companies are in financial centres, where new supplies of capital are obtained, distant from any part of their lines. Close supervision of active operations must, therefore, in such cases be intrusted to officials in immediate charge, and it is a reasonable assumption that among the great lines of this country the progress of development has been towards an increase of the duties, powers, and responsibilities of the trained railway officials except in matters that are strictly of a financial nature, and even in them on some lines.

ACCOUNTING AND TREASURY DEPARTMENTS.

Of the total reported number of employés of all railway companies in the United States in 1880, 3,375, or nearly one per cent., were designated general officers, and 8,655, or more than two per cent., were general office clerks. The labors of the latter are as necessary to the efficient performance of the duties of the directors and executive heads as the exertions of the clerks in the departments at Washington are to members of the Cabinet and President of the United States. An immense number of accounts of many descriptions must be revised, and conveniently arranged, or tabulated, so that statements and statistics throwing a flood of light on any important branch of road operations can be conveniently obtained, and checks established in reference to all classes of receipts and expenditures.

In improvement of methods and increase of available force for accomplishing such objects notable advances have occurred. Some of the large companies have auditors at the head of each of the three departments of freight receipts and disbursements, passenger receipts, and general disbursements; and each of these auditors requires a large number of assistants. A similar condition of things exists in reference to the operations of other classes of officials in general offices to such an extent that railway accounting has become one of the most important branches of railway service.

Some roads classify their officials and assistants under five heads, one of which is the accounting department; others combine the accounting department with the treasury department; others intrust a large share of the duties belonging to an accounting department to officials under the direction of heads of an operating department. There may or may not be special causes for such diversities as exist. Some companies presumably attach more importance than others to a thorough discharge of various duties, and there are also great differences in the amount of labor to be performed of any kind by accounting departments, arising from differences in volume of traffic. As railway operations expand, one of the directions in which a notable increase of checks becomes necessary is in reference to passenger fares. Originally there was no such thing as tickets, and the changes made from the starting point, at which numerous stations are established, where tickets can be purchased, are multitudinous. Under some of the most thorough of the modern systems the tickets are traced through all their ramifications, and safeguards are thus provided against peculation on the part of conductors which were formerly unattainable. In the single matter of preventing a railway company from being defrauded of portions of its revenue from passenger traffic great advances have been made in some instances, and the experience of a number of lines has shown the necessity of comprehensive action on this subject. Formerly railway companies were, in regard to passenger receipts, largely at the mercy of their conductors, and while many of them were and are honest men, there were some to whom the remarks are applicable which appeared a few years ago in the following sketch in the Indianapolis News:—

RAILWAY CONDUCTORS.

"The old-time railroad conductor, of which no pure type remains at this day, was one of the nabobs of the earth. To him life was a balmy, gentle summer's day. His income was determined by the limit of his desire. He was one of those officials rarely to be met with who could find no legitimate complaint over the size of his earnings, inasmuch as he fixed them himself. Before tickets came into general use upon the railroads, all money of course passed through the conductor's fingers. He was practically the railroad company so far as passenger receipts were concerned. He received the money, and no man knew how much he received. He declared dividends, large or small, and paid over the company's per cent., and no one could say him nay. He was paid as a matter of formality, a certain salary. Just why this was done it is difficult to see, unless it was designed by the company thus to make him think he was considered honest and flatter him thereby into a more favorable division of receipts. The old conductor grew rich, and retired to spend the remainder of his days in the enjoyment of his wealth.

The ticket system was designed to cut off the conductor's revenue and turn it into the treasury of the company. Its adoption was, perhaps, to a certain extent, successful. But while it did not leave the conductor so many opportunities to turn an honest penny, it made him more vigilant and greedy in regard to those opportunities that were left. Many men who travel regularly over certain lines establish an acquaintance with the conductors and discover their plan of operations. With such the conductors often divide the spoils by taking less than the regular fare, thus making it to the interest of such men not to purchase tickets. Instances of this method of mutual division and silence sometimes extend over many years. The conductor will pass through the train, greet the familiar acquaintance, while the f. a. drops, perhaps, half the regular fare into his hand, and it is sufficient. Once this arrangement begun, and the conductor, were he disposed to become honest, dares not do so. Usually with persons he does not know he will take out the book for registering fares, which he is required to carry, and, with a great show, seem to register a fare, though the paper over which his pencil seems to pass, may be innocent of blot or blemish. The conductors who are thus 'crooked,' running on the same road, will usually have an understanding with one another as to what percentage of money collected shall be retained. This is necessary in order that one man may not uniformly report larger receipts than others, and thus give the thing away. It is proverbial that if an honest conductor gets on a road where a majority or all of them are dishonest he will find his place very uncomfortable, and is likely to be the victim of some plot that will result in his discharge. Thus certain roads are known to have dishonest conductors throughout, while on others all seem to be honest. An honest man going on the road where the conductors are generally dishonest often feels that he must do as they do as a matter of self-defence, and comes in time to look upon it as legitimate.

Various devices are adopted by the railroads to prevent the conductors from stealing, but none as yet have been entirely successful, and if any man will offer one that will fill the bill the railroad companies will rise up and call him blessed. The plan of announcing that an extra per cent. would be charged passengers who failed to purchase tickets worked well enough with people who did not travel much, and did not know the wicked ways of the world, but it failed to reach the old hands, who knew the ropes. Spotters are sometimes employed, and certain roads seem to make it a rule to discharge their whole force of conductors every few months. Some roads now require the conductor to give for every cash fare a receipt, which in printed terms informs the passenger that if all was not right he may secure such state of affairs by taking the trouble to address Mr. Soandso, the general passenger agent. He is requested to preserve this receipt. He generally throws it on the floor or out of the window."

While it would be unjust to accept as literally correct all the above statements, so far as they affect an entire class of men who embrace many worthy citizens among their number, the extract helps to indicate one of many directions in which a thorough system of accounting and watchful supervision is necessary or desirable.

Of railway conductors, as a class, including freight conductors, it should be remembered that they worthily fill important and highly responsible positions, as they direct or control train movements, the other parties engaged in them being subject to their orders.

STATION AGENTS.

One of the most numerous classes of railway employés is station agents. It is necessary that all their operations should be carefully supervised, as they are the recipients of the principal portion of railway revenue. It occasionally, but rarely, happens that notices of defalcations of employés of this class are published. Ordinarily their receipts are forwarded and accounted for with commendable regularity. A considerable number of them receive large sums, but many others are located at such unimportant places that it is necessary, as a matter of economy, that they should perform a variety of duties to earn a living salary. The following picture of the day's labors and annoyances of the latter class was drawn by one of their number, in an article he contributed to the Bee Line Gazette a few years ago:—

"Give us a chance to see what the small station agent has to say for himself.

He gets up in the morning before daylight to attend to the local freight. When it comes along the freight is unloaded anywhere within a mile from the freight house, and the agent, who has nothing else to do, lugs it in alone. Then, perchance, there is a car to go, and then the train men dance, and say he has been holding that particular car for over a week, and swear they will get laid out if they take it. The local gone, and freight all in freight house, he goes home to breakfast in a tolerable state of humor. Returning to the station at 7 A. M., he finds several lady passengers waiting for the 9 o'clock train. No chance to sweep up and clean until that comes. Pretty soon they commence to bother him just as he is making out his reports, and he has to explain why children fifteen years of age cannot ride for half fare, or some such point. Before that is done with some one comes banging around for a box of freight, and will not be satisfied until the agent has shown him every box in the freight house, and has promised to telegraph and find out where his box is being held. He then returns to office, and the train dispatcher wants to know if he is laying off, and why don't he answer his call. If he tries to explain, dispatcher thinks he is impudent, and says he will see the superintendent about it, and if the agent don't try to explain, he will get reported for not doing so. Then, when dispatcher is sending special order, passenger comes to ticket window, and wants to know how soon the train will come, and if it is on time. At last, train is nearly due, when in comes a man who has five or ten dollars to send by express, and who, after spoiling three or four envelopes, finally gets one to suit him, and then wants agent to count money for him. He expects to send a barrel of potatoes to Michigan in the fall, and wants to know how much it will cost, and if the agent cannot get a lower rate if he ships three or four barrels. Then the train comes, and before he can get his baggage and express off and on the conductor and engineer are calling for their order, and he is rushed to the office to get it.

The train gone, he commences to sweep out and clean up; no sooner has he finished sweeping three or four rooms and a long platform, than there are some cars to be moved; he gets his pinch bar and shoves and pinches for the next thirty minutes, and finally gets back to office in time to find out that somebody has had a Western Union message and has been calling him all morning, and has requested the dispatcher to stir the agent up a little. The agent very likely feels stirred, but has to be resigned and quiet when told that a new man will take his place if he don't stay in the office all day and attend to business better. Dinner time comes at all hours, and some times would not come at all if the agent did not steal off to dinner, snatch a bite and rush back just in time to have another racket from the dispatcher. If a freight train gets laid out twenty minutes at a small station, the conductor gets wild and swears at the agent for not getting special orders after the dispatcher has given him '9.' He walks out of the office in disgust and gets as far as the freight house, when he finds something new. Some one has left a hay-rack full of household goods strewed all over the freight floor. Pretty soon another load comes, and finally, about dark, a lady comes round and wants her goods shipped by the first train. It is supper time. The passenger train is due in thirty minutes. He has to sell tickets, check baggage, get the United States mails, finish up his reports, and then go out in the freight house, and, after tugging and straining himself on cook stoves, bureaus, boxes and barrels and things of every description, loosely packed, poorly nailed, and liable to come apart at any time, he finds that he has thirty minutes left to eat his supper, bill the freight, make out the releases, and help the poor woman mark her goods and nail her boxes and barrels over. Then he gets his parting instructions to handle her goods very carefully and to tell the train men to do the same. Along comes the local two hours late, pitch dark and raining; the conductor sees the platform full of freight, and may be he is civil. Finally the freight is loaded and the cars all switched, and then he finds out that the dispatcher wanted to get the train to the next station, but could not raise the small station agent.

And so it goes day after day. Every one, from the head to the foot, has a pick at him, and even the brakemen swear if he is not on hand to open a switch every time a train wants to take a siding. The ticket department is no better. It generally pays a small commission on ticket sales as part of agent's salary. The men around the village, who do most of the traveling, want the agent to favor them in everything, and then they stand in with the conductor, and don't need to buy tickets. I have a dozen people get on a train at one time, and may be I sold one 25-cent ticket to the crowd. Some will not buy a ticket because the agent won't trust them for it, and others think it very stylish to pay the money to the conductor. Excursions, fairs, circus, and such generally send the agent a complimentary ticket, but they know well that he can never get off to use it. He is penned up from daylight until 9 P. M., and liable to get called up at any hour during the night. Thus you have him—station agent, baggage master, ticket agent, freight agent, express agent, mail carrier, switchman, and, finally, operator. His salary runs from $40 to $50 per month, and he is expected to be always civil, obliging, accommodating, and ready to give way for a new man, if he calls for promotion, after working four or five years at such a place. If any one thinks it's a picnic, I would advise him to try it for a short time."

THERE ARE NUMEROUS QUARTERS

in which the protection of the rights and interests of a railway company, which can be derived from a thorough system of accounting, is highly useful and important. The sphere of operations extends over many fields, in which large outlays are made or large receipts obtained. Freight departments are more important, in the magnitude of total revenue and complexity of details, than passenger departments. Nearly all the commercial products and much of the other movable property of the American people pass over railway lines, the actual value of the freight transported annually representing an aggregate of a number of billions of dollars, and as railway companies must strictly account for everything received, an immense amount of efficient clerical service, rendered in accordance with appropriate rules and regulations, is necessary.

Aside from all such matters, the road itself must be operated at an enormous expense, and considerable statistical information, showing the exact nature and magnitude of the numerous labors performed, and the precise cost of movements, furnish the best attainable data relating to the degree of skill and economy exercised in each department and by each class of officials and employés.

The treasury department proper of great lines, with heavy current receipts and expenses, and the duties it is frequently charged with in connection with the issue of new securities and the custody of stock transfer books, often has an immense amount of responsible labor to perform. In the case of companies where such duties are specially exacting and onerous it seems appropriate that they should be separated from the accounting departments.

Other important general office duties relate to the keeping of records in connection with real estate purchased from time to time, the movements of cars, and sundry other affairs. It is stated of an old New Hampshire railroad report that it embraced an enumeration of every tool owned by the company. This was going to a ridiculous length in one direction, but it was much better than to permit the wanton and injurious neglect of all such matters that has occurred in some other instances.

TRAFFIC DEPARTMENTS.

THE labors performed in general offices have an important relation to a large portion of the work connected with the traffic departments of railways, although much of their business is necessarily transacted at sundry points on or near portions of their lines, or at other places remote from the central office.

The moving of all the freight and passengers that are now moved on American railways, with the degree of safety and certainty that has been attained, at the prevailing low rate of average charges, is the greatest task ever performed by any combination of agencies, and the traffic departments deserve a liberal share of the credit of the wonderful achievements that are constantly being repeated.

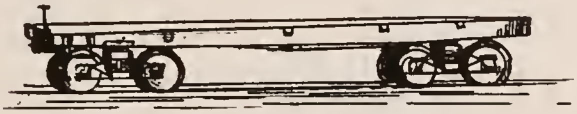
The sphere of the operations of important lines is extensive. In addition to the work constantly progressing on their own roads, which requires watchful supervision, they are often obliged to pay much attention to matters that may affect their prosperity that are transpiring or may transpire at numerous distant traffic centres. In general terms it may be said that every important company has a business representative stationed in or traveling through every region of the United States in which a considerable amount of traffic might be diverted to or from its lines. It was not by accident or neglect of any available method for attracting freight or passengers that the present routes of through business were established; and competition is at all times sufficiently active to render continuous efforts necessary to retain or increase the portion or percentage of traffic that is perpetually being contended for by rival organizations.

So much importance is attached to business originating off the lines operated that a number of companies extensively advertise lists of agents engaged in soliciting or directing it who are located in or traveling through widely-distant regions. One prominent road classifies its general and traveling agents under four heads, viz.: passenger and freight, embracing general agents and commercial agents; passenger, embracing a traffic agent, a number of traveling passenger agents, passenger agents whose fields of operation extend over large designated sections of the country, and district passenger agents; freight, embracing general agents for particular sections, commercial agents, a contracting agent, live stock agents, and numerous traveling agents; emigration, embracing a commercial and traveling emigration agent, and traveling emigration agents.

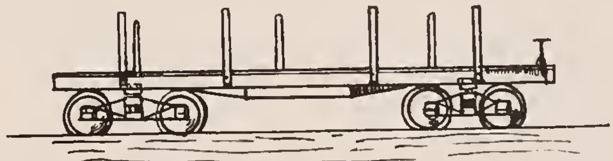
Other companies which do not extensively advertise lists of agents or business representatives in service at points distant from their lines nevertheless employ them presumably to the extent to which their services are considered advantageous.

Details of all extensive traffic departments are under the direction of two general heads, one being designated the general passenger and ticket agent, or general passenger agent, and the other the general freight agent, or general freight traffic agent. Some important companies have an officer who presumably outranks those named above, styled a general traffic manager, or a traffic manager, or a freight traffic manager, and some of the companies on which the amount of business is not specially extensive have an official designated traffic manager, or general freight and passenger agent, who has immediate charge of both branches of the traffic department. On the large systems each of the two great divisions of railway traffic has several important officials, whose headquarters are usually in the general office or in the city in which it is located, including an assistant general passenger and ticket agent, or assistant general passenger agent, and general baggage agent, in the passenger department, and one or more prominent assistants to the general freight agent.

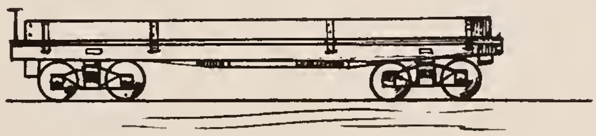
The division of traffic into the two classes of passenger and freight business runs throughout sundry ramifications of railway affairs, as it is not only requisite that two classes of officials should be employed, but that different classes of cars should be used, and in modern practice there are usually two classes



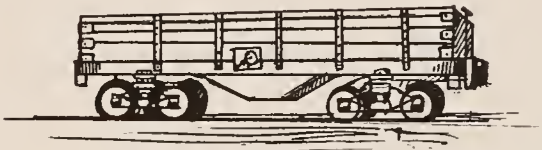
Flat Car.



Flat Car, with Stakes.

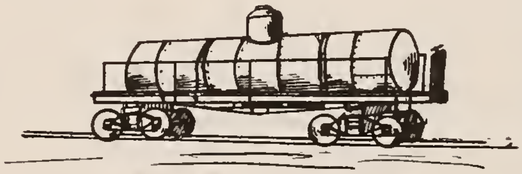


Gondola Car.

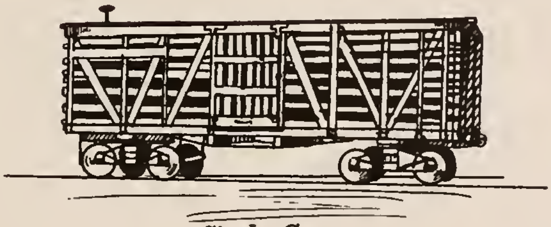


Hopper-bottom Gondola Car.

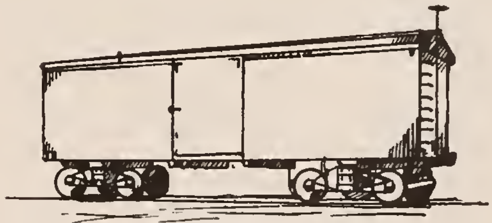
Iron-hopper Coal Car.



Tank Car or Oil Car.



Stock Car.



Box Car.

VARIOUS STYLES OF FREIGHT CARS.

of locomotives, enginemen, and brakemen. Endeavors are also made to apportion operating expenses, including the cost of maintenance of way, as closely as possible between the outlays required to transport passengers on the one hand, and freight on the other.

The traffic of large systems might also be divided into two other classes, one consisting of the business which apparently comes unsought, or without any special new efforts being made to attract or secure it except those arising from sufficient accommodations and ordinary advertising, and the other consisting of business obtained in sharp competition with rival lines, or by offering special inducements for the temporary or permanent increase of local passenger or freight movements.

Much has been done and is constantly being done in all these directions. Many of these labors were wise and judicious; some of them were unwise and injudicious, and any general remark that might be hazarded on this subject should perhaps be to the effect that efforts to develop local traffic have more frequently fallen short of a proper standard than efforts to secure a share of competitive traffic. The home market is apt to be the best market for railways as well as other producers. It is doubtful if any American railway company has ever enjoyed a large measure of continuous prosperity which did not develop or serve extensive interests located along its lines or at its terminal points, and it is certain that much money has been lost in carrying competitive traffic at unremunerative rates. At the same time, first-class local service can scarcely be rendered to all the inhabitants of regions traversed by lengthy lines unless they are thoroughly equipped for and engaged in competitive traffic, because it is generally necessary that a number of important local industries and interests should have at least equal chances with the producers of competing regions. For these and other reasons the ideal management of the traffic departments of great railways involves the solution of some of the most complicated problems that ever puzzled mankind, and their intricacies have been greatly increased by the pressure of competition, harassing legislation, and sharp transitions from booming eras to periods of industrial and commercial depression.

There are presumably important variations in the actual amount of power exercised by traffic managers, general passenger agents, and general freight agents, but all such officials usually have a large amount of business to direct. An indication of its magnitude is furnished by the following statement made in the St. Louis Globe-Democrat, shortly after the strike of 1885, on the Missouri Pacific system: "Very few people have any conception of the vast amount of correspondence which comes into the various traffic departments of a railroad. When the late strike was inaugurated on the south-western system, it was thought advisable to keep an accurate record of the number of letters received each day at the general passenger and ticket office at St. Louis, in order to determine what effect, if any, the strike had on the passenger business. Commencing with the 9th of March and ending with April 9th, there were received through the general post office 3,903 letters, and by train mail 10,939, an average of 530 per day, not including Sundays. From April 10th to May 10th, the general post office delivered 3,896 letters, and the train mail amounted to 10,823 letters, a daily average, excluding Sundays, of 566. This does not include telegrams, newspapers, or pamphlets and advertising matter. When it is remembered that this only covers the letters received by one department, and that it takes two clerks several hours each day to open and distribute the mail, some idea of the vast machinery it requires to manage and operate 5,000 miles of railway can be formed. A few years ago, before the organization of so many pools and traffic associations, and when the railway systems of the country were comparatively small, the correspondence of passenger and freight departments was easy to handle, as it was not a general rule to keep copies of all letters and telegrams sent out, but to trust more to memory. In many cases ordinary requests for rates or information were answered by simply turning down one corner of the letter, making the proper notation in pencil thereon, and returning it to the sender. That is all changed now, and a railroad official who would send out rates or information without carefully keeping a letter-press copy of the same would be apt to find himself in a disagreeable predicament before some pool commissioner, state railroad commissioner, or other association arbitrator."

Vivid pictures have been drawn of the character of the labors performed by general freight agents. If they were confined to the arrangement and printing of tariffs, and the supervision of details relating to current transactions, they would be sufficiently onerous. But numerous complicated questions affecting relations with connecting or rival lines frequently demand much attention, and agents are obliged to act promptly on an immense number of applications for special rates, or particular concessions, which are pressed with all the earnestness and artfulness that energetic business men can employ. Much has been said of the unscrupulousness of corporations, but if the other side of the story representing the nature of the demands made by individuals and communities could be fully presented, it might lead to the conclusion that there is a greater necessity for protecting railway corporations against ruinous aggressions, than for exceptional legislation to protect the public against "unjust discrimination."

The general passenger agent also has many applications to consider and dispose of, such as letters asking for special rates for excursionists of all classes, who wish to go to numerous places, and to travel for less than the regular rates on sundry occasions. The routine duties are highly important, and it frequently requires a considerable amount of wisdom and practical knowledge to decide doubtful questions, and to enable a company to fully improve its opportunities without being subjected to unnecessary expense.

One of the departments connected with passenger traffic, the handling of baggage, has been systematized on American railways to an extent that renders the facilities afforded for its safe keeping and delivery far superior to the arrangements of foreign roads, and this creditable result has only been attained by an immense amount of careful attention, watchful supervision, and clerical labor.

BAGGAGE HANDLERS—THE CHECKING SYSTEM.

The following sketch of some of the labors of baggage handlers and of the checking system is condensed from a description which appeared in the Philadelphia Times:—

"Standing in a railroad centre, where steaming engines rush into the station with trembling haste, one may observe the trunk smasher at his work, and stand in wonderment that he executes his task so skillfully, and yet with such little damage. A breathless span of time is allotted him to hand down his pile of trunks, and to the minute the work is done. All around him is the roar of a shifting, steaming world, embarking and disembarking in exciting speed, and the only man that stands cool at his place in the midst of this seething Babylon is the expert baggage master.

To be a trunk handler one must be an expert. None but men of peculiar fitness are stationed at the great railroad exchanges. A greenhorn can at once be detected. He tackles a trunk with bungling awkwardness, he rolls it with puffing labor, falls over it, and tilts and drops it a score of times. To watch an expert unloading a train you will observe how his one hand rests upon one corner and the other upon the side. He lands the trunk upon the floor, never upon any corner, always on the full end. The corner is the wrecking point even of an iron-clad. He most dexterously hurries it to one side with the ease of a toy, and hurls another after it with the grace and pose of a ball player. He always prefers a large trunk to a small one; it is better to handle. The wrecking is never done by an expert who handles hundreds of trunks at the great confluences of railroads. It is done by the small fries of the least work, and particularly by the inexperienced hands of road expresses.

A baggage master is alert and very jealous of his record. He makes no claim to the title of 'trunk smasher,' he rather repudiates it as a slur on his calling. Besides every damage is chalked against him, and a second default jeopardizes his position.

He decidedly is king among checks. They are mysterious hieroglyphics, those brass plates as they hang dangling by leathern thongs in his office. They are mute intelligences that will cling to the handle of any pretentious trunk and chaperon him to the end of the nation with unerring precision of the way and through intricate manœuverings of exchanges. There is the 'shell check,' that will safely steer the luggage as far as the Vandalia line goes—to Indianapolis. Then the 'joint checks,' that vacillate between the Pennsylvania and the New York, West Shore and Buffalo railroads. The 'reversible check' is a curiosity. It takes baggage out to a certain destination, reverses, and takes it back again. The 'local check' is used on any road the given company operates, and guides its charge with triplicates. The most universally used check is the 'Thomas holder.' It goes over the Philadelphia and Reading Railroad, and is a favorite of steamboats. There are checks of all shapes—round, square, oval, and even of Maltese-cross cut. They are sober facts in trunk travel, and so must the checking master be. When the tide of an excited multitude is upon him, bellowing and rushing around his unguarded post, he must be cool and make no mistakes. It often so happens that he must lead some flurried traveler to his sober senses or half-guess what in his nervous excitement he desires. That a trunk breaks is often the fault of the trunk itself. It is packed to an explosion and is not strapped. That a trunk is lost is rather the fault of the excited traveler, who is indefinite in his destination or who may jostle his goods to the wrong order. The baggage master is pains-taking—he checks for records of goods at both ends and keeps an account in his own office. If a trunk is lost the 'tracer' is sent out. It may be a chase of weeks until the stray goods are ferreted out. It is a piece of detective work and admits of skill and natural shrewdness, this hunting after a trunk that has lost its bearings.

The baggage master politely checks your trunk and says nothing unless it be overweight. He will allow you 150 pounds for a full ticket and 75 pounds for a half ticket. It is simply 20 cents per hundred pounds in excess to a given distance. If you quietly pay you will save yourself unnecessary dispute. The trunk smasher has his rights, and if you observe him at his work of tossing trunks.you must admit that he makes good use of them."

LEGAL DEPARTMENTS.

EVERY important railway has a general counsel, general solicitor, general attorney, or solicitor, who usually has talented assistants in the central office, and a corps of leading lawyers, residing in the districts traversed, regularly engaged to conduct such cases as may require attention in sundry courts. Various roads respectively designate the central legal officials as general counsel, general solicitor, and assistant general solicitors; general solicitor and an assistant general solicitor; general counsel and assistant general counsel; general solicitor and chief counsel; general counsel; solicitor; general attorney; general counsel and general attorney; general counsel and counsel; chief attorney; general counsel; a general attorney for each of several important districts; a general claim agent and assistant general claim agent.

Whatever may be the special titles or plan of organization adopted, there is comparatively little difference in the leading characteristics of several classes of important legal labors that must be performed, although the variations in their details are as numerous as the complexities of financial management, the scope of corporate ambition, the vagaries of legislative railway reformers, the conflicts of railway laws, the perversities of juries, and the extortionate fancies of men who claim damages for loss of real or personal property, or physical injuries.

The leading counsel acts as the adviser of the president and board of directors in important matters that demand consideration, and gives judicious opinions in reference to the bearing of laws and decisions upon such schemes as may be proposed, or work that may be progressing, or means for obtaining financial aid, such as a new mortgage, &c. He is also generally expected to advocate the interests of the company in prominent cases that are to be argued before the higher courts, to draw up important contracts or other papers, and to appear as a defender of railway rights before legislative or congressional committees when specially dangerous new aggressions are under consideration.

These classes of duties are to a considerable extent distinct from an immense mass of current business arising from claims of various descriptions, such as those based on land damages; the destruction of live stock; the burning of buildings, fences, or crops by fires caused by the sparks of a locomotive; the infliction of injuries upon individuals at grade crossings or other points on railway lines; the loss of baggage or portions of freight shipped; personal injuries inflicted on employés or passengers by railway accidents; and sundry other incidents.

To decide what the laws bearing on certain classes of railway operations really are is often a difficult task, on account of the multiplicity of loosely-worded statutes and conflicting judicial opinions. And when the laws are known or fixed, the facts involved in particular cases are distorted to an extent that would be ruinous to struggling companies if they were not defended by able counsel. There is little doubt that gross injustice is frequently submitted to because such submission involves less loss than trials controlled by what Marshall M. Kirkman styles "an unwritten law of the land that leads the juryman to cast his verdict for his neighbor whenever a conflict occurs between him and a railway company."

There has been a material change in the policy pursued by some important corporations within a comparatively recent period. For stubborn resistance to nearly all classes of claims, an earnest desire to promptly meet and pay without litigation all reasonably just demands has been substituted. There is little doubt that the latter course is commendable, and that the interests of powerful companies are promoted by the manifestation of a desire to deal justly with real sufferers, combined with a firm resistance to fraudulent claims and determined efforts to prevent the establishment of legal principles or precedents that would be specially damaging to railway interests. One of the features of railway organization which is gaining importance is the departments specially charged with duties connected with claims, some of the agents being styled general claim agents, and others freight claim agents. The extent to which they are closely connected with legal departments presumably varies in different corporations.

The current proceedings in many of the courts of the country show that a large portion of their time is occupied with the consideration of suits in which railway companies are defendants, and it is not uncommon for one company to be indulging in the luxury of litigation against another. Scarcely a week passes that a peculiarly outrageous verdict or decision is not rendered in some locality, and the aggregate amount of injustice inflicted in this way, and in the passage of unjust laws by legislative bodies, or the issue of unjust edicts by railway commissions, probably exceeds the amount of legalized injustice inflicted upon all other American interests.

Despite zealous efforts to adjust disputes amicably, and to promptly pay every description of just claims, an immense amount of railway litigation is usually progressing. The general counsel of an important road, who was noted for his anxiety to avoid appeals to the courts as far as possible, stated before a legislative committee that within a year nearly four hundred suits had been brought against the company he represented, and that about nineteen hundred suits in which it was concerned were then pending, many of the latter being old cases.

The services of sagacious counsel are necessary in each stage of development of a railway, from the initiatory steps, in which papers must be drawn up, or arguments made to secure a charter or obtain a right of way, through all grades of legislative and popular friendship or hostility, up to and through the period when the volume of daily traffic has gained stupendous proportions, and incidentally furnished the basis for legal entanglements of corresponding variety and magnitude. Every step of railway progress is paved with lawsuits and requirements of law-makers.

The nature of the changes of popular proclivities, which frequently bring with them corresponding variations in the specially pressing duties of legal departments, are forcibly described in the following article, written a few years ago, which, although it is peculiarly applicable to the lines running through new agricultural regions, depicts manifestations in nearly all localities:—

THREE EPOCHS OF RAILROADS.

"The first is the formation epoch. The people of a section want a railroad. Everybody wants it. There is no division of sentiment. Public meetings are held, and the enthusiasm is only surpassed by the unanimity of sentiment. Every variety of local aid is voted, and the right of way is freely given. No sacrifice is considered too great; eternal frienship is pledged to its interests; the company, the corporation, the monopoly, is regarded as an unseen but benignant power.

The second epoch is like the first. It is the construction epoch. The road is being built. Town sites are selected. Country villages bristle with activity and life. The whole country shows signs of prosperity. Money is paid out in every direction for labor, teams, provisions, supplies, ties, everything which enters into the construction of the road. Especially the price of land advances. Farms increase 40, 50, 500 per cent. in value. Farmers put in big crops, as they will find a market at their doors. The road is at length completed. The rejoicing is general. The first train is welcomed as an army of deliverance by a people in bondage. Everybody feels good. It is true also that everybody's expectations have been realized. All the advantages of the railroad are appreciated and its value admitted.

The third epoch then slowly emerges. Its early progress is slow; it then approaches with accelerated speed. The public learns that the road is not run for its exclusive benefit, but that the company also expects to make some money out of it. The discovery is made that the railroad is not a purely philanthropic enterprise. The boundless benefits, including increased values, steady markets, means of rapid communication, the prosperity of the country, have become seasoned and threadbare facts; they have lost their novelty; they are old; they seem as if they had always been, like the beauties of nature.

Then a hostile feeling arises. People who had formerly ridden by stage coach at the rate of 60 miles a day, and paid from 6 to 10 cents a mile, complain that the railroads, which run 600 miles in 24 hours, do not make fast enough time, and that 4 cents a mile is extortion. Those who used to draw wheat 40 miles to market, and sell it for 50 cents a bushel, complain of the cost of transportation, though they sell their wheat for one dollar a bushel at a distance of 40 rods from their granaries. Complaint is made that railroad officers give free passes and free rides, and everybody who cannot get one becomes an enemy of the road for that reason. In the end hostile orders are formed. The grangers arise in their wrathful might. Destructive legislation, like the Potter laws, is enacted. The public faith, guaranteed to the railroad in its inception, is broken; a blow is aimed at the general prosperity; credit is impaired; capital is scared, and withdraws its supplies from the channels of commerce and industry; disaster and collapse ensue; the railroad company goes into bankruptcy, and the property into the hands of a receiver, and the paralysis of hard times settles down upon every enterprise of trade, of labor, and investment.

This is not a fancy sketch. It is drawn on the hard lines of facts and experience. It has lessons also which may well 'be heeded and be a guide for the future.'"

OPERATING DEPARTMENTS.

THERE are considerable variations in the details of railway organizations when the scope of their operations is substantially similar; and other changes result from differences in labors performed. One of the most important of the latter class arises from the establishment of construction departments by some companies which are generally building new lines of varying length, or erecting new bridges, stations, and terminal facilities, or improving their roads to a notable extent by adding new tracks or straightening old ones. When the amount of new construction and improvements is particularly large the duties and responsibilities of this department are specially onerous, and much may depend upon its discretion and efficiency. A large proportion of the railway building of recent years was conducted under the direction of established lines, and urgent necessities for extensive improvements of old roads were developed. But the creation of construction departments is an exceptional proceeding; and they are a distinct feature in only a small minority of the existing companies. Even in some cases in which a considerable amount of new work is progressing it is under the general charge of officers identified with the operating departments.

There are differences of considerable magnitude in the spirit that prevails on different lines, which grow out of the relative degree of importance attached to the temporary or protracted attainment of satisfactory financial results, at the risk of a serious deterioration in condition of road-bed or rolling stock. Where the best intentions prevail it is often found exceedingly difficult, if not impossible, to subdivide the gross amounts available for current expenditures, so as to make due provision for all important requirements, and to prevent a relative excess of outlays in some quarters and damaging deficiencies in others. Useful plans for avoiding such discrepancies by a thorough interchange of opinion and discussion among operating officers have been devised.

All large companies have a chief engineer, whose duties vary materially with the magnitude of improvements and extensions, but he is frequently subject to the directions of the head of the operating department, and in a few companies acts in that capacity, being at once the chief engineer and general superintendent.

The current work of railways, aside from the direction of financial matters heretofore referred to, is performed by the operating department, and its head usually governs all classes of officials and employés engaged in active duties connected with the manufacture of transportation, whether they keep the permanent way in proper order, or participate in train movements, or aid in securing or giving due attention to freight or passenger traffic.

In ordinary dealings, as travelers and transporters, the general public rarely comes in direct contact with any class of employés who are not part of the operating department. These men and the property under their immediate charge are, for all practical purposes, apparently the railway. The other important features of organization are unseen, notwithstanding the great extent to which their influence is or may be exercised, as a controlling power, and as a guardian of the capital which called the railway into existence, provides means for its improvement, and asks, but often in vain, for a legitimate share of the profits of railway labors.

The duties of operating departments steadily increase with the growth of traffic, the increase of the speed of fast trains, and of the number of trains run at varying degrees of speed.

On the early lines of this country, and on a considerable portion of the existing mileage on which the amount of business is only sufficient to need the movement of a few trains each way daily, the requirements are comparatively simple. But to portions of a number of American roads the following description of leading features of an important English line is, with slight variations, substantially applicable: "The traffic consists of varying elements. There are express and mail passenger trains running at a speed of 45 miles an hour, and even more in some cases; others at a somewhat less speed; stopping trains, calling at every station, and running at a rate of from 20 to 25 miles an hour; local suburban trains, running for short distances at a fairly high rate of speed, chiefly for residential purposes; express goods trains between the larger towns, attaining a speed of 20 or 25 miles an hour; slow, stopping goods trains, for serving smaller towns and villages; and, finally, the heavy coal trains running out of the great colliery districts to every centre of population. All these trains, heavy and light, fast and slow, some stopping at the stations and others dashing through them at high rates of speed, have to be accommodated to a great extent upon the same line of rails, yet to keep their time and fulfill their appointed functions—and, briefly, this is the great problem which railway management has to solve. Such a service cannot be carried on under all circumstances—whether by night or day, in fogs, in snow storms, in wind or rain, and under all other adverse conditions—without entailing hardships and dangers upon the men engaged in the working."

Whether the amount of business is large or small, an effective organization must be maintained, men qualified to perform each of a number of distinct duties must be ever ready to discharge their allotted tasks faithfully and fearlessly, and strict discipline must be maintained, especially among trainmen, and all other classes closely connected with train movements. It is as necessary in a railway working force as in an army that the men who undertake to do certain things should obey orders, and be held to a rigid responsibility. Carelessness, inattention, neglect, or unskillful service are fruitful causes of the accidents that are painfully frequent, despite the best efforts to ward off dangers arising from delinquencies of employés; and in the absence of incessant efforts, by the appropriate officials, to compel due attention to proper rules, by reprimanding or punishing offenders by fines, penalties, temporary suspension from duty, reduction of rank or pay, or dismissal, the employés on some roads would become sadly demoralized. The art of managing men, so as to secure their hearty co-operation, or to extract from them the full measure of efficient service, and to so distribute the various elements of the working force as to render it available for appropriate purposes in the highest attainable degree, is an indispensable requisite in a successful general manager, general superintendent, or division superintendent. No other qualities he may possess would compensate for a material defect in this particular.

The importance of this quality of being able to manage men effectively probably accounts for a considerable variety in the antecedents of those who have risen through subordinate grades to become division superintendents, and subsequently general superintendents or general managers. It is stated that in England it is no unusual thing for a station master, by reason of special aptitude, to rise to the position of division superintendent or even general manager. In this country notable promotions have been more frequent among men who commenced their railway labors in positions connected with engineering, train-movement, or telegraphic departments, and first gained considerable prominence as division superintendents.

The unit of the operating department is a division. However large a system or lengthy a line may be, it is formed of a number of divisions, each distinct in important respects from any other, and each having appurtenances similar to those possessed by others, however widely they may differ in detail. Each has its family of officials and employés, and usually its own shops for repairing cars and locomotives, and appliances for removing wrecks, and rendering damaged portions of the permanent way passable as quickly as possible after it has suffered exceptional injuries. In modern practice the persons employed on each division of important roads frequently include skillful civil engineers, whose duties consist principally in supervising labors intended to keep the permanent way in proper order, as well as all the classes of active working railway forces needed to move trains.

The list of employés connected with the transportation department of an important road, as described in its published rules, include men designated as follows:—

Enginemen, firemen, brakemen, passenger conductors, passenger brakemen, freight conductors, freight brakemen.

Train masters and assistants, depot masters, yard dispatchers, yard clerks, road firemen of engines.

Station agents, telegraph operators, foremen of road repairs, switchmen, road and bridge watchmen, general baggage agent, station baggage agents, baggage masters, division operators, telegraph operators (under the direction of the division operator), line repairmen, track repairmen.

Master mechanics and foremen of machine and car shops, shop clerks, foreman of car inspectors, car inspectors, keepers of road and coal stations, supervisors, switchmen, switch watchmen, general foreman of maintenance-of-way mechanics, including carpenters, masons, and painters; road and bridge switchmen, night watchmen, switch tenders.

The jurisdiction of the general manager usually extends over all the units of organization, somewhat in the manner in which the authority of a general extends over the regiments of a brigade, each of which has its distinct existence under the direction of a colonel and his subordinate officials. Details vary, but the characteristics of some organizations are represented by the following statement of the officials of the several lines of the Plant system, who were organized as an advisory board of its general manager, viz.: Superintendents, assistant superintendents, chief or consulting engineers, comptrollers, treasurers, masters of roadway or road masters, masters of machinery, masters of transportation, general freight agents, general ticket or passenger agents, purchasing agents, auditors, assistant general counsel. Another enumeration of the general operating officers designates them as follows: General manager, chief engineer, solicitor, general passenger or ticket agent, general freight agent, purchasing agent, division superintendents, auditor, local treasurer.

Each class of employés has its duties defined, generally in an explicit manner, but one of the important directions of progress has been towards an increase of precision in sundry rules and regulations, especially those relating to train movements.

LABORS ON RAILWAY TRACKS.

THERE are ideal railway tracks so complete in all their appointments that little or nothing is left to desire. But they form only a small proportion of the existing mileage, and usually even the lines which contain gems of constructive railway art have not hitherto been able to command sufficient means to bring all divisions and sections fully up to such standards as they wish to establish, except in characteristics necessary to promote safety. The work of keeping roads in proper repair, intermingled with such betterments from time to time as financial conditions will permit, goes on incessantly, with wide variations in the expenditures per mile for such purposes. In regard to track labors instructive remarks were made a few years ago by Benjamin Reece, then chief engineer of the Lake Shore and Michigan Southern, west of Toledo, in a paper read before the American Society of Civil Engineers, from which the following statements are extracted:—

SECTION FOREMEN AND TRACKMEN.

"Inventors have taxed their ingenuity and have devised and tested many forms of fastenings to improve our joints; engineers and engineering societies have devoted themselves to the discovery of some economic plan of preserving ties and timber from decay; railroads have kept careful and elaborate record of the life of rails; mechanical tests and chemical analysis have been made to determine the composition best adapted for our use; while this important factor in the maintenance of way, the section foreman, how little we have studied him, and yet upon his shoulders largely rests the work of properly caring for this material, which every branch of our profession has contributed its full share of scientific research and experience to perfect.

It is largely with a view of impressing upon the mind of the foreman his personal responsibility and individual accountability for the condition of his section, that I discontinued the use of extra gangs in the making of ordinary track repairs. Prior to making the change the extra gang was charged with being the author of all the ills from which the section suffered, and, although the extra gang was thus made the scapegoat, it was not without some shadow of justice. An extra gang foreman has no interest in the section upon which he is engaged, excepting to complete the work laid out for him, which he frequently does with more reference to speed than thoroughness. Particularly is this the case when the points at which the men are working afford poor or expensive living accommodation for the men. . . .

This tendency to a want of thoroughness in making repairs to track, although more marked, is not confined to extra gang foremen. The importance of strict thoroughness is not understood or appreciated by nine-tenths of the section foremen, and I may say, three-fourths of the road masters of the country. In nothing do these men need to be so fully drilled as in the importance of thorough and conscientious track work, particularly in tamping, to stand the service to which our tracks are subjected. To track foremen the condition of the track is largely a matter of appearance to the eye, and too frequently they are led into hurried styles of work, covering too much ground in a day, often impelled by a desire to make a better showing; they are content to shovel tamp, or if bars are used the work is not well done, and though the tracks may be very pleasant to look at, a few weeks' traffic destroys the surface line and level, and the same track must again receive attention.

Much of our defective track is due to careless and insufficient tamping. In all cases where the track is being surfaced I require the tamping bar to be used. Insufficient bar tamping is almost invariably followed by general instability of the track, which, even while in fair level and surface, can readily be noticed while riding over it. As might be expected, the surface and level are soon destroyed, the spikes pull, ties churn, rails cut into good oak ties, and it is no uncommon thing, even on our best roads, to see the ties of one section badly cut in by the flange of the rail, while the adjoining sections, with the same general condition of road-bed, ballast, and material, are almost entirely free from the evils mentioned. This, I am satisfied, is largely attributable to the difference in tamping. On the division of road under my charge we have used the tamping bar entirely for surfacing and leveling track, and, while the results were gratifying, there remained much room for improvement. The commendable desire of foremen to go over the entire section, coupled with a lack of calculation to ascertain the daily performance necessary to attain that end, even with good, ambitious, conscientious men, often leads to less thoroughness of work than I deem essential to a proper and economical maintenance of way. I found, almost invariably, that our active but slower-going foreman, in the seeming amount of work performed, had the best and most enduring track. I have a number of cases in my mind, but one so marked that I will mention it. The section in question is one of the hardest to maintain on the line, having many curves and a continuous heavy grade. The sections east and west were of the same general character, but in a less degree. The three sections had what one would call good section foremen, and yet the section of which I speak, although the hardest to maintain, was always in better condition than the other two. I could tell it upon the train the minute the car crossed the section line by a firmness and stability which was quite marked in comparison. In fall and spring this section was invariably in better condition and repair than its neighbors. An investigation showed that, in his summer work, while equally energetic, the foreman did not get over more than three-fourths the ground worked in a day on the adjoining sections, which led me to believe more thorough work was done. I have seen good, energetic, faithful foremen fail because they tried to get over too much ground."

THE NIGHT WATCHMAN OR TRACK WALKER.

A few years ago a Pittsburgh journal published a sketch of the labors of a night track walker who had been on duty for thirty-two years on a section of the Pennsylvania Railroad near Pittsburgh, but who had been transferred to a less laborious position a short time before he gave the following brief sketch of his protracted labors:—

"It was in 1853," he tells the writer, while sitting in his little parlor, "that I first went on duty as a track walker. The Pennsylvania road had just been built. In those days there waren't so many trains as there are now," and the old man gave a quiet chuckle. "There was but one track. Well, I had a section of track two and a half miles long to look after, and I made two trips a night. Then they began putting down more tracks and I had more work to do. Yes, it is pretty hard work to walk the track. When they used to put down iron rails I had lots of trouble with them. You see when there would once come a cold snap, the rails would break sometimes. Whole pieces would fly out. I remember one night several years ago, while going up the track, I heard a sound like a musket shot. I knew what the trouble was. The night express was just about due, and I hurried along as lively as I could. It was a dreadfully cold night. Well, up the track a distance I came across the trouble. Fully a yard off one of the rails had been broken by the frost and the piece had been thrown by the explosion, dear knows where! I had just time to hurry down the track and signal the express to stop. If I had missed seeing that broken piece, I don't know just what would have happened, but the express would have gone down over the hill. I remember another time, during the coldest weather I ever saw in all those years, of finding three broken rails in one night.

They were all bad breaks, and any one of them would have caused a wreck." "Did you have any narrow escapes yourself?" "I did one time. If I hadn't jumped down over an embankment the limited express would have knocked me over. I felt it strike my coat-tails, but the spring I made saved me. But I always kept my ears open, and though often I got sleepy on my walk, I never relaxed my vigilance. Sometimes, on hot summer nights, I would have to bathe my face in water to keep myself awake. No, there was never a wreck on my walk caused by any trouble with the track. But sometimes I made discoveries just in the nick of time to save a wreck."

CLEARING AWAY RAILWAY WRECKS.

As disasters will occasionally happen, in spite of all the pains that may be taken, and as they are sometimes caused by gross neglect, it is desirable that effective means should be provided for the prompt removal of all obstructions. The following description of a representative labor of this kind, which has had many counterparts, was forwarded to a western journal by its New York correspondent:—

"A gentleman tells me that he has seen one of the most extraordinary pieces of executive dispatch in his life. 'I was coming down the Hudson River road,' he said, 'two or three days ago, when the train was stopped by a wreck near Hudson. A freight train had been thrown off the track. The engine was lying imbedded in a hole, one car was lying across the track, another had lost its trucks and was flat on the track, and the tender of the locomotive was also deeply imbedded. We had waited there an hour and a half or two hours, and twenty trains had been stopped. They had yanked one of the cars up on jack-screws, as if to run trucks under it, and then get it out of the way. It looked as if we were going to stay until night, and we began to think about finding a steamboat or buggy or something to get on to New York, when all at once an engine and wrecking car heaved in sight. Before the engine had come to a stop we could hear the road master's voice ring out, giving his orders before he had seen the situation. He seemed to be as familiar with everything on the spot as if he had been there all night. There was an engine off at some distance, but doing nothing. He called out to the engineer to come up and make fast to the buried locomotive. In half a minute the engine was attached and pulling to get the other out of the hole, and at the second effort the great mass of iron came up sullenly, and was hauled out of the road. 'Pass that rope over the top of that car and make fast to that tree yonder,' he cried. It was done. 'Now five hundred of you lay hold of that rope,' he shouted. The entire little army, under the inspiration of that voice, laid hold of the rope, using the tree for a purchase, and they pulled the car across the track square out of the way by main strength. 'Come on here with that engine,' he cried again, 'and make fast to this truck.' With another tremendous pull the whole thing came out of the ground like a tree by the roots, and was rushed off. 'Now start that first train,' cried the man. In less than two minutes from the time of his arrival what looked to be a week's job was out of the way, and the passengers went on."

TRAIN MOVEMENTS.

WE are frequently told that a railway is a public highway and in one sense this statement is quite correct. We are also informed that an operating railway company is a common carrier. This is also true. But before the days of railways operated under present systems, although there was an abundance of highways, and a large number of common carriers, there was no such thing as a combination of the ownership or control of a superior highway, with the control of the movements of all the vehicles passing over it, and it is only such a combination and the use of superior vehicles and motive power that has made the swift modern passenger trains and heavy freight trains possibilities. The railway companies that send them daily and hourly on their errands are something more than owners or lessees of highways and common carriers. They are *manufacturers of transportation,* and the moving train is the product of labors infinitely more varied, exacting, intricate, complicated, and expensive than those undertaken by any other class of manufacturers.

The headquarters of divisions of important railways are great workshops, where various grades of mechanical talent are marshaled under a master mechanic and a master car builder, and aside from these shops, there are central shops, frequently of great magnitude, where much new construction, including locomotives and cars, is ordinarily progressing, in addition to an immense amount of repairing. All the great old standard trades applicable to transportation have been subdivided into numerous branches, and the railways are liberal patrons of them all. One of the greatest of modern changes arises from the extent to which such subdivisions have been carried. It would be hard to say how many departments of industry are now represented by labors that could formerly have been performed, if at all, only by a blacksmith. It is estimated that American railways use at least half the iron produced in the country, and the country now produces in busy years about five times as much iron as the whole world produced before the dawn of the present century. Aside from this use of iron, and the constant employment of skillful mechanics and assistants of numerous grades, including a large force necessary to keep the permanent way in proper condition, the running of many trains at various speeds upon a single roadway, is an operation of great complexity. There must be not only skillful enginemen, firemen, conductors, and brakemen, but dispatchers, signalmen, and telegraph operators—in short, the entire organization is more complex and extensive than was ever combined for any other peaceful business pursuit.

To manufacture transportation at the rate that work is performed daily in the vicinity of large cities, with hundreds of outcoming and incoming trains, so regularly and safely that an accident to a passenger or the loss of baggage is a rare occurrence, is a feat that gives to the organization which performs it a character widely different from that of the traditionary highway owner or common carrier. The railway is the great employer of men, money, and machinery, and the link by which it makes the connection with the public is THE TRAIN.

REQUIREMENTS OF RAILWAY TRAIN SERVICE.

The following description of the qualities considered desirable or necessary in men employed in railway train service was given by division superintendent A. M. Richards, of the Chicago and Alton Railway, to a railroad reporter of a western journal:—

"Every man in railway train service acquires a nerve and executive force and obedience that is worked into his very soul by the character of his employment. He is a true soldier. He believes that he knows his own duty and can and will do it, and he expects the same of every man above or below him. The unforgiven sin in railroading is incompetency. If constitutional, or often shown, no penance or prayers will save the unlucky possessor's head. Incompetency in railroading is an intolerable defect, and can offer no excuses. Regarding the Chicago and Alton train men, Mr. Richards ranks them high in every respect. A comparatively modern thing required in railroading is total abstinence. In former times a little indulgence in the social bowl was winked at. But whisky has been found a foe of railroading. It has caused the loss of a good many lives and much money. Railroad managers have learned that a man who drinks is dangerous. Hence if he indulges even off duty he is discharged. If he is on duty at night and then stays up during the day time he is likewise bounced for not going to bed. He may be warned once of his faults, but a repetition costs him his job. Railroads must have not only clear brains but well-rested bodies. It wants every man at his best. Formerly the 'hail fellow well met' man was likely to rise in authority in railroading. This is no longer true. Conviviality is frowned upon everywhere in the service. Urbanity is expected of all, but debauchery permitted in none.

The railroads employ no green man after he is 40. It is considered then that he is too old to be taught the business. Every applicant is required to sign a statement showing where he worked for three years last past. Railroad men wear out faster than others, but are well paid and kept by the road that employs them to old age if their powers do not fail and so impair their usefulness. Good eyesight is especially required and good hearing is very important. Railroading has become a great profession or trade and a sure one. To men of broad ability it offers fine opportunities to rise to good positions of excellent salaries. Managing officials' salaries on good roads run from $2,000 per year up. But Darwin's theory of the 'survival of the fittest' finds inexorable sway here, and only men gifted for their respective duties go up to higher positions, while if only mediocre a man cannot even enter the lower ranks. The railroad service employs essentially picked men throughout. Mr. Richards says that nearly all managers and chiefs of departments are men who rose in the service with no training prior to entering it. But he expects the time will come when special railroad training schools will be founded and eventually recognized by railroad managers as efficient aids in laying the foundations of successful railroad careers. The trade or profession as such he expects to take higher and yet higher rank and thinks the grade of efficiency required is likely to rise gradually till the service has attained human perfection."

TRAIN DISPATCHERS.

There are a number of classes of employés at work on the lines of railway companies, particularly those on which many trains are moved, and extra precautions to secure safety thereby rendered necessary. Increase of traffic usually leads to a great increase of the importance of the responsibilities of signalmen, telegraph operators, and train dispatchers, as errors or omissions on their part may be attended with damaging or fatal results.

The following sketch of the labors of the train dispatcher was published in the Philadelphia Times:—

"His position in the railway service is unique. Were all trains running on time, and provided for on the periodical time table issued by the company, he would have no duties to perform; but trains will get delayed, and occasions will arise requiring extra trains, or trains without any specified time or rights, to be run over the road, and then his services are necessary to avoid hours of delay.

All trains on railroads are divided in classes, according to their importance, generally two, passenger and freight; and all trains of one class running in a specified direction have the right of road, or need keep no lookout for trains of the same or a lower class running in the opposite direction. Thus it is assumed that on a certain railroad trains running eastward have the right of way over trains running westward. Then an east-bound passenger train can run the whole length of the road in entire disregard of all trains. Another passenger train going west need only look out for the east-bound passenger train, while the freight trains must keep out of the way of both passenger trains and of the freight train which is running in the direction prescribed as having the right of road.

Every one understands that all trains are chartered or have a time given for passing each station, which time can in no instance be anticipated, and hence all train men know where all other trains ought to be at any particular moment, if on time; but as trains frequently and generally get late the train of inferior class must have its movement expedited by some extraneous cause or it may be delayed for hours awaiting a train that may have been wrecked or has been kept back for some other of many causes. Then the duties of the train dispatcher are of importance. He will probably give an order to the delayed train by telegraph directing it not to go beyond a certain place which he thinks it can reach without difficulty, and he directs the opposing train to proceed to the same place and there pass the other train, and in that manner the trains are enabled to pass each other without any delay to either. His great responsibility consists in that he may have a dozen other trains in his charge at the same time, and in directing one train to go beyond its usual place to meet another he may neglect to give an order to the second train, and in such an event a collision would probably ensue, much property be destroyed, and probably lives be lost.

It will readily be seen that the slightest mistake of a train dispatcher might cause serious results, and in this respect his responsibility is probably greater than that of any other individual under whose charge the public are placed. A pilot on a vessel may lose his reckoning, but the fact soon becomes apparent to others, and his capacity for mischief is thereby lessened. Other railway employés may neglect their duties, and rush headlong into danger, but their associates generally realize the situation before any unfortunate results ensue; but the slightest behest of the train dispatcher must be obeyed without question, even though to do so would jeopardise the lives of those receiving the orders, though, of course, until an accident results the train men are ignorant of the fact that they have been given wrong directions.

Instances of oversight of dispatchers are extremely rare, much less than of neglect of conductors and engineers to adhere to the orders given to them, and while they perform their onerous duties almost entirely unknown to the people whose lives they have in their control, and, therefore, never receive the meed of praise due them, travelers ought at least be made acquainted with their duties, and the important part they play in the rapid and safe movement of passengers."

LOCOMOTIVE ENGINEERS.

There is no class of railway employés in whom a deeper interest has been manifested by the public, or upon whose skill, discretion, and fidelity, as displayed from day to day and hour to hour, more depends, than the men variously styled enginemen, engineers, engine drivers, locomotive engineers, locomotive runners, and train runners. In the selection and management of such important assistants, and their assignment to different duties, it is necessary that good judgment should be exercised; and it is still more necessary that in conducting their labors they should display the peculiar combinations of mental and physical qualities which secure the best results.

As a rule all engineers undergo a protracted preliminary training as locomotive firemen, and a large number of the firemen begin their railway careers as brakemen, a position from which advances are made in several directions, the most common being either towards promotion as a fireman or as a conductor. Systematic training for service as a locomotive engigineer usually forms part of the labors of firemen, and it is generally preceded by a considerable amount of incidental preliminary training, either as a brakemen or as an assistant in cleaning engines. Labors of the latter class precede an appointment as fireman in England.

In all countries protracted experience and numerous proofs of capacity in running freight trains precede advancement to the position of engineer of a passenger locomotive. Progress is comparatively slow. There is much to be learned thoroughly. Formerly a large amount of knowledge in regard to the construction of the locomotive was considered necessary, but now the chief requisite is a thorough mastery of the art of running a locomotive. This includes, in addition to all that must be known of the details of the machine, and the manner in which it must be handled to obtain desired results, a thorough knowledge of the road to be traversed, the meaning of signals, the regulation of brakes, variations in grades, defects in track and their probable effect, the art of being on time, and sundry other matters. Ability to control the machine must be combined with self-control, and an avoidance of excitability in the presence of actual or prospective danger. The working capacity of the best of engineers is quickly weakened or destroyed if they become nervous or fidgety. One authority says they "are neither born nor made; they grow." Another says "they are not made; they are born, and unless nature designed them for engineers a lifetime devoted to training will not make them experts. Nature makes the engineer, and he is fitted for his duty by training."

One of the descriptions of their current labors, which originally appeared in the Public Ledger, says:—

"To secure safety the engineer sits upon the right side of his engine, in such a position as to command a clear view of the road, having within his reach the lever for starting or stopping the engine, the cord attached to steam whistle, the rod leading to the sand box, because the sanding of the track when sudden stoppages are needed in times of threatened disaster is an important adjunct; the lever of the pump, to keep the boiler properly supplied with water, and, what is of equal importance, the small lever which applies power to all the brakes of the passenger train at the same moment. Now one would think, with all these various levers, cords, and rods, the engineer would not possibly have time to keep a good lookout and attend to them, but he does, and so quietly and with such system that a stranger on the engine would scarcely notice that he had touched any of them. But watch closely, and it will be seen that while the train is moving at the rate of forty or fifty miles an hour the water cocks are tried to see how the water stands in the boiler, and perhaps the next thing necessary will be the starting of the pump, and while doing this a sign tells the engineer that he is approaching a country road at grade or a station, and he must, therefore, sound the whistle. If the fireman be a new man, he has to be watched, and often directed when to put coal on, but if well acquainted with the business, he gives the engineer but little trouble in this respect. So systematic is the work of the engineer, and so well does he know the capacity of the engine and the various grades of the road, that it is scarcely necessary for him to look at the clock in his cab to ascertain if he is on time. If he starts on time, but is afterwards delayed at the stations, he knows exactly the places of the road where he expects to make up the loss, and keep up his reputation for always coming in on time. The engineer who is always getting in late does not gain many friends, and cannot expect to hold first-class positions very long.

The running of trains in daylight is not attended with near so much danger as at night, as the engineers can see at a great distance, and, therefore, avoid or prevent accidents from obstructions, but at night there is constant anxiety, and the utmost vigilance is necessary. The head-light on the locomotive is of more value to those who are walking upon the track, or about to cross it, than it is to the engineer. A tie laid across the track, or a cow or man walking upon it, would be seen, but unless the man or cow got off they would certainly be struck, because when a train is moving at the rate of thirty or forty miles an hour it would pass over at least one-fourth of the distance in view from the time of the discovery before the brake could be fully applied; but the speed would be very much lessened, and though the engine might be thrown from the track, the engineer and firemen would have time to escape in many cases by jumping from the train. Nearly every engineer who has been in the service for many years can relate many tales of wreck and narrow escapes from death or severe injuries, but still they are not deterred from continuing the same business, but their vigilance is redoubled to prevent future mishaps."

An English writer, in discussing their labors, says: "Consider the operation of climbing and descending a 'summit' or descending and then climbing a 'valley.' At these times the driver's hand is never off the lever. In the course of a few miles he will, perhaps, make fifty imperceptible changes in the speed of the train—accelerating it or diminishing it so steadily that not a passenger notices what is being done. That is the perfection of engine driving. This is the climax of the driver's skill, and he attains it coincidentally with the full development of those qualities which he has unconsciously trained within himself, and which are all governed by an overmastering sense of duty."

The following account of an experience in a collision was attributed, by a correspondent of the Philadelphia Times, to an engineer:—

"I ran into a freight train just as I rounded a curve on the mountain side, going west. An assistant superintendent was aboard and he was urging me to make a siding where a freight was expected. The train was running at the rate of thirty-five miles an hour. The engineer of the freight train expected us and he was running slow and had reversed. I had just time to shut off steam and jump. The fireman jumped also and landed thirty feet away in a field. I landed on the other side and was struck by flying splinters and badly cut in the head, which laid me up two weeks. The collision was terrific. Eighteen freight cars and the coaches of my train were piled on top of each other. The wreck was a terrible one. The baggage master on my train was killed and several passengers were badly hurt. The engineer and fireman of the freight train escaped by jumping. My engine was so badly broken up that she could not be repaired and was cut up for old iron. Never want to go through such a scene again. It was like a flash of lightning and I knew nothing."

CONDUCTORS AND BRAKEMEN.

All train movements usually require the services of a conductor and brakemen, in addition to the locomotive engineer and fireman. The position of the conductor involves special responsibility, as he is generally in charge of the train, and it is usually his duty to report to the division superintendent insubordination, neglect, or misconduct on the part of any other employé engaged in a train movement. The duties of brakemen subject them to more numerous dangers, and they are more frequently injured or killed, than any other class of railway operatives. Peril attends the coupling of cars, rapid movements from the top of one freight car to another while a train is in motion, and various other tasks.

DANGERS OF TRAIN MOVEMENTS.

Neglect of duty on the part of either of the four classes of men engaged in running trains, as well as failure to perform allotted tasks on the part of a number of other classes, including signal men, switchmen, telegraph operators, and train dispatchers, and also numerous kinds of defects in permanent way or rolling stock, may at any moment cause a railway accident. It is only by careful attention to a large number of details that the ground-work can be furnished of a reasonable prospect of the avoidance of serious disasters. That they occasionally occur is less surprising than that the number is not larger. To run numerous trains at a high rate of speed is to subject to a severe test the reliability of numerous persons and appliances, and it is almost inevitable that weak spots should be occasionally developed either in men, materials, or machinery. Methods of guarding against them or of warding off particular perils, and of diminishing the destructiveness of disasters, have been the subject of anxious deliberations ever since railway operations commenced; and despite the multiplicity of inventions no mechanical safeguard can furnish a substitute for careful, well-trained, and skillful employés. The faithful services of such men are not only necessary to secure train movements but also to make them reasonably safe. The necessity of strictly enforcing appropriate rules and regulations, and administering rebukes or punishments corresponding to each definite offence that has caused disasters, or is likely to cause them, if repeated, is, therefore, obvious; and it would not be surprising if something like a perpetual court-martial was progressing at the division headquarters of some of the railways of the country. Independent of all other aids to safety a notable improvement in the train rules adopted by many lines is one of the results of protracted labors of the General Time Convention.

ENGRAVED BY CROSSCUP & WEST ENGRAVING COMPANY

MODERN RAILWAY TRANSPORTATION.

FROM A PAINTING BY N. H. TROTTER FOR H. H. HOUSTON.

GENERAL RULES GOVERNING TRAIN SERVICE.

IN addition to the organization and control of the forces of each operating railway company by its appropriate officers, and the enlargement of systems that has led to an immense increase in the number of persons subject to the jurisdiction of their heads, there has been a strong tendency during late years towards an increase of the number and influence of bodies of particular classes of officials representing a large number of distinct railway companies, and affecting or controlling, in varying degrees, their action on sundry questions. Reference has already been made to railway confederations, traffic associations, the master car builders, and master mechanics. Some of their duties have been to decide questions affecting common interests and demanding solution which, from their nature, could not be fully decided by any one company or system, such as minute classifications of freight, regulation of rates between numerous competing points, establishment of rules governing the interchange of cars, &c. The intricacy and importance of the subjects discussed increase with the growth of traffic, and there are sundry other bodies than those referred to above which have wholly or partially solved knotty problems of universal railway interest during a comparatively recent period.

Prominent in this list is the

GENERAL TIME CONVENTION,

composed of representatives of all railway companies that desire to participate in its proceedings. Its achievements embrace, in addition to current labors, which consist chiefly in the arrangement of satisfactory schedules of through trains, the general adoption of the existing system of standard time, and the recommendation of a uniform code of train signals and general train rules, and a code of rules for the management of trains by telegraphic orders.

The desirability of a code of uniform train rules is evident, on account of occasional changes among trainmen from the service of one company to the service of another; and when, as not infrequently happened, there was a material difference in the meaning of train signals, or other matters affecting train movements, the dangers of accidents were materially increased. Elaborate inquiries disclosed the fact that there were considerable diversities in the practices of different companies, and before a substantial agreement could be reached arduous labors were performed by a committee, and there were instructive discussions at successive meetings of the General Time Convention.

The initial step appears to have been taken at the convention held at St. Louis on April 11th, 1883, at which a resolution was adopted providing for the appointment of a committee of five, by the chair, to report to the next convention on the subject of uniform train signals. It consisted of Messrs. McCrea, Talmage, Thomas, Parker, and W. F. Medill. At the convention held at Chicago, on October 11th, 1883, it presented a report signed by James McCrea, chairman (manager Pittsburgh, Cincinnati and St. Louis Railway, Chicago, St. Louis and Pittsburgh, and Jeffersonville, Madison and Indianapolis railroads); A. A. Talmage (general manager transportation Missouri Pacific Railway and leased lines); George W. Parker (vice-president and general manager St. Louis, Alton and Terre Haute Railroad); and E. B. Thomas (general manager Cleveland, Columbus, Cincinnati and Indianapolis Railway and Indianapolis and St. Louis Railway); by Robert Blee.

The convention decided that a copy of this report should be furnished to the managing officer of each of the railroads of the country, with the request that they would signify their assent or objection to the same, and, with the understanding that the subject would be taken up for further consideration at the next meeting. It was held at Cincinnati on April 9th, 1884, and the general subject received further consideration. A summary of a vote showing the views of numerous companies on some of the signals recommended was presented. In response to circulars 196 companies, representing a mileage of 58,503, had expressed opinions. Of these, 168 roads, with a mileage of 46,048, favored the hand and lamp signals proposed; 167 roads, with a mileage of 41,882, favored the bell-cord signals; 169 roads, with a mileage of 42,702, favored the whistle signals; 163 roads, with a mileage of 45,985, favored the stationary and fixed signals; 173 roads, with a mileage of 48,877, favored the torpedo signals; 158 roads, with a mileage of 50,034, agreed to adopt the system if a majority of the convention favored it; 19 roads, with a mileage of 2,389, agreed to adopt the system if it was adopted by their connecting roads. After some discussion, action was postponed until the fall meeting, which was held in Philadelphia on October 9th, 1884. At that meeting a summary was presented of the views of a number of companies, which showed that, exclusive of sundry roads represented in the convention, which presumably agreed to the system proposed, roads with a mileage of 24,909 agreed to adopt it with the fall change of time-tables; roads with a mileage of 26,898 agreed to adopt it provided it was adopted by connecting lines; roads with a mileage of 954 agreed to adopt it at a later date than the fall change in the time table; and roads with a mileage of 4,662 agreed to adopt the greater portion of the system. The negative vote represented a mileage of 15,035. A resolution was unanimously passed declaring that the convention adopted the signals recommended by the committee, to take effect with the new time-tables, November 16th, 1884.

At this meeting a resolution was also adopted providing for the appointment of a committee of five to submit a system of uniform telegraph orders and general rules for governing train service. The president appointed a committee, consisting of Messrs. K. H. Wade, general superintendent Wabash, St. Louis and Pacific Railway; H. B. Stone, general manager Chicago, Burlington and Quincy Railroad; J. T. Harahan, general manager Louisville and Nashville Railroad; C. D. Gorham, superintendent Western division New York, Chicago and St. Louis Railway, and Robert Pitcairn, general agent and superintendent Pittsburgh division Pennsylvania Railroad, which was subsequently enlarged by the appointment of H. Walters, general manager Atlantic Coast Line; E. B. Thomas, general manager Richmond and Danville system, and William Rogers, general superintendent Central and South-western railroads, of Georgia. The committee addressed circulars to a large number of companies, obtaining indications of their diversified views and practices, and made an elaborate report at the General Time Convention held in St. Louis, April 8th, 1885.

Subsequently they held a number of meetings at various places, and a protracted discussion of the rules proposed occurred at sessions of the convention held in New York on October 13th and 14th, 1886. The result was the approval of a code of general and train rules which substantially embrace provisions for nearly all the uniform train signals previously recommended, and which were to be finally acted upon at a meeting held in New York on April 13th, 1887. At that meeting further discussions occurred, and, after a few amendments, the rules were adopted by a vote of 49 ayes, 5 noes. A code of rules for the movement of trains by telegraphic orders was also provisionally adopted at the same convention. At the fall meeting, held in New York on October 12th, 1887, a report was presented by the committee on uniform train rules, in which a few slight modifications were recommended, and a few amendments of the rules for the movement of trains by telegraphic orders were proposed, after which they were finally adopted by a vote of 58 to 2. Some of the rules are subject to minor modifications, but the principal portion of the rules governing train service are already in force on many of the lines and, as a whole, they presumably represent the present or prospective standard railway practice of the country.

An important auxiliary step, which was practically completed before the uniform train signals were adopted, but while they were under consideration, was the adoption of

STANDARD TIME.

The report of the United States commissioner of railroads, dated November 1st, 1883, in referring to this subject, says: "The question of uniform time standards for railways in the United States has long attracted the attention of railway managers, but Mr. W. F. Allen, editor of the Travelers' Official Guide, and secretary of the time conventions, is entitled to the credit of having perfected the admirable system which was adopted by the General Time Convention of railway managers, held at Chicago, October 11th, 1883, and ratified by the Southern Railway Time Convention, held at New York, October 17th, 1883.

As this is a subject of great interest to the entire country, a brief synopsis of the general principles governing the proposed plan is deemed appropriate in this report.

Under the present system each railway is operated independently on the local time of some principal point or points on said road, but this plan was found to be highly objectionable, owing to the fact that some fifty standards, intersecting and interlacing each other, were in use throughout the country. By the plan which has been adopted this number will be reduced to four, the difference in time being one hour between each, viz., the 75th, 90th, 105th, and 120th degrees of longitude west from Greenwich. The adoption of these standards will not cause a difference of more than thirty minutes from the local time at any point which is now used as a standard. The new arrangement goes into effect November 18th, 1883, and all changes of time are to occur at the termini of roads, or at the ends of divisions. The 75th meridian being almost precisely the central meridian for the system of roads now using standards based upon the time of the eastern cities, and the 90th meridian being equally central for roads now running by the time of western cities, the time of these meridians has been adopted for the territory which includes 90 per cent. of the whole railway system of the country. Nearly all of the large cities have abolished local time and adopted that of the nearest standard meridian in use by the railways."

The code of train rules provides for the use of standard time transmitted from observations in various portions of the country, including Albany, Allegheny, Ann Arbor, Cambridge, Chicago, Cincinnati, Jefferson City, Madison, New Haven, Northfield, St. Louis, St. Paul, and Washington, and each conductor and engineman is required to have a reliable watch, which must be regulated by a designated standard clock before starting on each trip. There are 121 train rules, all of which are considered important, from which the following are selected as illustrations of railway practice in reference to the matters to which they refer:—

SIGNAL RULES.

Signals.

Conductors, enginemen, firemen, brakemen, station agents, telegraph operators, switchmen, switch tenders, track foremen, road and bridge watchmen, and all other employés whose duties may require them to give signals must provide themselves with the proper appliances, and keep them in good order and always ready for immediate use.

Flags of the proper color must be used by day, and lamps of the proper color by night, or whenever from fog or other cause the day signals cannot be clearly seen.

Red signifies *danger*, and is a signal to stop.

Green signifies *caution*, and is a signal to go slowly.

White signifies *safety*, and is a signal to go on.

Green and white is a signal to be used to stop trains at flag stations for passengers or freight.

Blue is a signal to be used by car inspectors.

An explosive cap or torpedo, placed on the top of the rail, is a signal to be used *in addition* to the regular signals.

The explosion of *one* torpedo is a signal to *stop* immediately; the explosion of *two* torpedoes is a signal to *reduce speed* immediately, and look out for a danger signal.

A fusee is an *extra* danger signal, to be lighted and placed on the track at night, in cases of accident or emergency.

A train finding a fusee burning upon the track must come to a stop, and not proceed until it is burned out.

A flag or lamp swung across the track, a hat or any object waved violently by any person on the track, signifies danger, and is a signal to stop.

Train Signals.

Each train, while running, must display two green flags by day and two green lights by night, one on each side of the rear of the train, as markers, to indicate the rear of the train. Yard engines will not display markers.

Each train running after sunset, or when obscured by fog or other cause, must display the head-light in front, and two or more red lights in the rear. Yard engines must display two green lights instead of red, except when provided with a head-light on both front and rear.

Each car on a passenger train while running must be in communication with the engine. In the absence of an equivalent appliance, a bell cord must be attached to the signal bell of the engine, passing through or over the entire length of the train, and secured to the rear end of it.

Two green flags by day and two green lights by night, displayed in the places provided for that purpose on the front of an engine, denote that the train is followed by another train, running on the same schedule and entitled to the same time-table rights as the train carrying the signals.

Two white flags by day and two white lights by night, displayed in the places provided for that purpose on the front of an engine, denote that the train is an extra. These signals must be displayed by all extra trains, but not by yard engines.

A blue flag by day and a blue light by night, placed on the end of a car, denote that car inspectors are at work under or about the car or train. The car or train thus protected must not be coupled to, or removed, until the blue signal is moved by the car inspectors.

When a car standing on a siding is protected by a blue signal, other cars must not be placed in front of it so that the blue signal will be obscured, without first notifying the car inspector, that he protect himself.

Whistle Signals.

One *long* blast of the whistle is the signal for approaching stations, railroad crossing, and junctions (thus ——).

One *short* blast of the whistle is the signal to apply the brakes—stop (thus, -).

Two *long* blasts of the whistle is the signal to throw off the brakes (thus, —— ——).

Two *short* blasts of the whistle is an answer to any signal except "train parted" (thus, - -).

Three *long* blasts of the whistle (to be repeated until answered), is a signal that the train has parted (thus, —— —— ——).

Three *short* blasts of the whistle, when the train is *standing* (to be repeated until answered), is a signal that the train will back (thus, - - -).

Four *long* blasts of the whistle is the signal to call in the flagman (thus, —— —— —— ——).

Four *short* blasts of the whistle is the engineman's call for signals from switch tenders, watchmen, trainmen, and others (thus, - - - -).

Five *short* blasts of the whistle is a signal to the flagman to go back and protect the rear of the train (- - - - -).

One *long* followed by two *short* blasts of the whistle is a signal to be given by trains on single track, when displaying signals for a following train, to call the attention of trains of the same or inferior class to the signals displayed (thus, —— - -).

Two *long* followed by two *short* blasts of the whistle is the signal for approaching road crossings at grade (thus, —— —— - -).

A succession of *short* blasts of the whistle is an alarm for persons or cattle on the track, and calls the attention of trainmen to danger ahead.

Bell-Cord Signals.

One tap of the signal bell, when the train is *standing*, is the signal to start.

Two taps of the signal bell, when the train is *running*, is the signal to stop at once.

Two taps of the signal bell, when the train is *standing*, is the signal to call in the flagman.

Three taps of the signal bell, when the train is *running*, is the signal to stop at the next station.

Three taps of the signal bell, when the train is *standing*, is the signal to back the train.

Four taps of the signal bell, when the train is *running*, is the signal to reduce speed.

When one tap of the signal bell is heard, while the train is *running*, the engineman must immediately ascertain if the train is parted.

Signals of the same number of sounds shall have the same significance when given by other appliances than bell-cords and signal bells.

Lamp Signals.

A lamp swung across the track is the signal to stop.

A lamp raised and lowered vertically is the signal to move ahead.

A lamp swung vertically in a circle across the track, when the train is *standing*, is the signal to move back.

A lamp swung vertically in a circle at arm's length across the track, when the train is *running*, is the signal that the train has parted.

A flag, or the hand, moved in any of the directions given above will indicate the same signal as given by a lamp. . . .

TRAIN RULES.

Classification of Trains.

All trains are designated as regular or extra. Regular trains are those represented on the time-table, and may consist of one or more sections. All sections of a train, except the last, must display signals. Extra trains are those not represented on the time-table. An engine without cars, in service on the road, shall be considered a train.

All regular trains are classified on the time-table with regard to their priority of right to the track; trains of the first class being superior to those of the second and all succeeding classes, and trains of the second class being superior to those of the third and all succeeding classes; and so on indefinitely. The terms passenger, freight, or mixed are descriptive and do not refer to class.

Extra trains may be distinguished as:—

Passenger extra, or special;

Freight extra;

Work train extra.

All extra trains are of inferior class to all regular trains of whatever class.

A train of inferior class must in all cases keep out of the way of a train of superior class.

On single track, all trains in one direction, specified in time-table, have the absolute right of track over trains of the same class running in the opposite direction.

When trains of the same class meet on single track, the train not having right of track must take the siding and be clear of the main track before the leaving time of the opposing train; but such trains must not pass the switch to back in on a siding, until after the arrival of the opposing train, unless otherwise directed by special instructions. When necessary to back in on the siding, before passing the switch, a flagman must be sent out in the direction of the opposing train.

When a train of inferior class meets a train of superior class on single track, the train of inferior class must take the siding and clear the train of superior class *five* minutes. A train of inferior class must keep *five* minutes off the time of a train of superior class following it.

A train must not leave a station to follow a passenger train until *five* minutes after the departure of such passenger train, unless some form of block signal is used.

Passenger trains running in the same direction must keep not less than *five* minutes apart, unless some form of block signal is used.

Freight trains following each other must keep not less than *five* minutes apart (except in closing up at stations or at meeting and passing points) unless some form of block signal is used.

No train must leave a station expecting to meet or to be passed at the next station by a train having the right of track, unless it has full schedule time to make the meeting or passing point, or unless it has the full time allowed between stations (which may be shown on the margin of the time-table) to make the meeting or passing point, and clear the track by the time required.

When a passenger train is detained at any of its usual stops more than ——— minutes, the flagman must go back with danger signals and protect his train; but if it stops at any unusual point the flagman must immediately go back far enough to be seen from a train moving in the same direction when it is at least ——— from the rear of his own train.

When it is necessary to protect the front of the train, the same precaution must be observed by the fireman. If the fireman is unable to leave the engine, the front brakeman must be sent in his place.

When a freight train is detained at any of its usual stops more than ——— minutes, where the rear of the train can be plainly seen from a train moving in the same direction at a distance of at least ———, the flagman must go back with danger signals not less than ———, and as much further as may be necessary to protect his train; but if the rear of his train cannot be plainly seen at a distance of at least ———, or if it stops at any point that is not its usual stopping place, the flagman must go back not less than ———.

When it is necessary to protect the front of the train, the same precautions must be observed by the fireman. If the fireman is unable to leave the engine, the front brakeman must be sent in his place.

When it is necessary for the flagman to go back to protect the rear of his train, the next brakeman must immediately take the flagman's position on the train, and remain there until relieved by the flagman, and on passenger trains the baggage master must take the place of the front brakeman whenever necessary.

When a train is stopped by an accident or obstruction, the flagman must immediately go back with danger signals to stop any train moving in the same direction. At a point ——— from the rear of his train he must place *one* torpedo on the rail. He must then continue to go back at least ——— from the rear of his train, and place *two* torpedoes on the rail, ten yards apart (one rail length), when he may return to a point ——— from the rear of his train, and he must remain there until recalled by the whistle of his engine; but if a passenger train is due within *ten* minutes he must remain until it arrives. When he comes in he will remove the torpedo nearest the train, but the *two* torpedoes must be left on the rail as a caution signal to any following train.

If the accident or obstruction occurs upon single track, and it becomes necessary to protect the front of the train, or if any other track is obstructed, the fireman must go forward and use the same precautions. If the fireman is unable to leave the engine, the front brakeman must be sent in his place. . . .

If a train should part while in motion, trainmen must use great care to prevent the detached parts from coming into collision. Enginemen must give the signal, and keep the front part of the train in motion until the detached portion is stopped.

The front portion will have the right to go back, regardless of all trains, to recover the detached portion, first sending a flagman with danger signals ——— in the direction in which the train is to be backed, and running with great caution, at a speed not exceeding four miles per hour. On single track all the precautions required by the rules must also be taken to protect the train against opposing trains. *The detached portion must not be moved or passed around until the front portion comes back.* This rule applies to trains of every class.

An exception will only be made to the above when it is known that the detached portion has been stopped, and when the whole occurrence is in plain view, no curves or other obstructions intervening, so that signals can be seen from both portions of the train. In that event the conductor and engineman may arrange for the recoupling, using the greatest caution.

When a train is being pushed by an engine (except when shifting and making up trains in yards) a flagman must be stationed in a conspicuous position on the front of the leading car, so as to perceive the first sign of danger and immediately signal the engineman.

A train starting from a station, or leaving a junction, when a train of the same class running in the same direction is overdue, will proceed on its own time and rights, and the overdue train will run as provided in rule — or —.

A train which is delayed, and falls back on the time of another train of the same class, does not lose its rights.

Regular trains twelve hours or more behind their schedule time lose all their rights.

A train overtaking another train of the same or superior class, *disabled so that it cannot move*, will run around it, assuming the rights and taking the orders of the disabled train, to the next telegraph office which is open, where it will report to the superintendent. The disabled train will assume the rights of the last train passing it, till the next telegraph office is reached.

Work trains will be run as extras under special orders, and will be assigned working limits.

Great care must be exercised by the trainmen of a train approaching a station where any train is receiving or discharging passengers.

Enginemen must observe trains on the opposite track, and if they are running too closely together call attention to the fact.

No person will be permitted to ride on an engine except the engineman, fireman, and other designated employés, in the discharge of their duties, without a written order from the proper authority.

Conductors will be held responsible for the proper adjustment of the switches used by them and their trainmen, except where switch tenders are stationed.

Whoever opens a switch shall remain at it until it is closed, unless relieved by some other competent employé.

When there is more than one train to use a switch it must not be left open unless one of the trainmen of the following train is at the switch and takes charge of it.

Accidents, detention of trains, failure in supply of water or fuel, or defects in the track or bridges, must be promptly reported by telegraph to the superintendent.

No train shall leave a station without a signal from its conductor.

Conductors and enginemen will be held equally responsible for the violation of any of the rules governing the safety of their trains, *and they must take every precaution for the protection of their trains, even if not provided for by the rules.*

In all cases of doubt and uncertainty, take the safe course and run no risks.

PREPARATIONS FOR TRAIN MOVEMENTS.

Each train movement, however short, may be attended with disasters that will leave an indelible impression upon the minds of the trainmen engaged in it, or possibly cause death. Precautions for safety and comfort are always in order. One of the best descriptions we have seen of the course pursued in connection with such matters, is contained in the following extract from a paper on the working of traffic upon single-track railroads in the United States and Canada, read before the British Scientific Association, at their meeting in Canada, in August, 1884, by W. K. Muir:—

"Suppose that we have properly equipped trains, and something to run with, and a suitable track to run upon, and trusty men in charge of the train; that would mean for a passenger train, bodies of coaches and windows thoroughly cleaned, outside of axle boxes and running gear scrubbed with a brush and lye solution, and all oil and grease cut off; the running gear and air brakes known to be reliable, the bell-rope properly strung from the engine cab to the end platform of the rear coach and tested to see that it is O. K.; the cars internally scrupulously clean, water coolers filled with fresh ice water, lamps trimmed, good ventilation, the temperature moderate, a thermometer suspended in the middle of the car to guide in regulating the temperature, the trainmen neat, clean, perfectly sober and in uniform, the baggageman in his car and the conductor (who is responsible for the working of his train, and the tickets or fares and comfort of his passengers) know that everything about his train is right, as regards signals, two red and two white flags, two red and two white and his own lamps, and the tail and side lamps, axe, saw, and hammer in each coach, and in his *tool box* in the baggage car a wrench, waste, oil, wick, detonating signals, dope, the proper signals on the front of the locomotive, neither he nor his men smoking on duty and all alert and attentive to train work and passengers and baggage. Know before he starts from the telegraph office about trains due and their position.

On the journey one brakeman should always be about upon the rear car, the other on the front end of the train near the baggage car, and the conductor, upon nearing stations at which he means to stop, somewhere between the baggage car and the middle of the train, and when he does stop, and before he starts, his men can tell him by signal or voice whether everything is right front and rear.

The freight-train men should know that the running gear of their cars is apparently right so far as they can see, the coupling links and pins of cars safe, no bolts dropped through the draw-bars and used for ordinary pins, their caboose or conductor's car neat, clean, and comfortable, with their kit of lamp, torpedo, and flag signals complete, spare links and pins, a crowbar, a set of portable frogs, a tail rope, two torches, chains, axe, saw, and wrench, supply of dope, or common brown soap and wood ashes, waste and oil.

If the train has a passenger coach, and is running as a mixed train, there should be a bell rope strung from cab of engine through open cleats on the roof of the freight cars to the rear platform of the coach. The caboose car should have side brackets for tail signals.

The trainmen should be seen by the yard master before they leave, and he should know positively that they are sober, fresh, and well rested, one brakeman on front to operate from that end, the conductor and other brakeman on the rear end of the train."

Of the labors of train dispatchers and various classes of railway employés whose movements affect train movements he forcibly says: "The essence of this whole operation means eternal vigilance in each and all of the departments."

RAILWAY ASSOCIATIONS AND ORGANIZATIONS.

IN addition to the bodies of various classes of railway officials or employés hitherto mentioned there are a number of others. One of the oldest is the National Association of General Passenger and Ticket Agents. At its meetings, held twice a year, in spring and fall, various matters relating to the arrangement of tickets, combinations of tickets providing for through travel, and passenger fares and routes are discussed, and the action of numerous companies on such subjects usually corresponds with the conclusions it reaches. Another organization, which performs analogous service in regard to regulations relating to baggage, is the National Association of General Baggage Agents. These two bodies have done much to promote the creation of the convenient existing arrangements for through travel and the safe custody and prompt delivery of baggage.

Meetings of railway accounting officers, for important special purposes connected with their duties, held in 1887-88, led to a proposition that a permanent association of such officers should be formed. Its purposes, as defined in a circular to railway companies, issued May 30th, 1888, by a committee, are "the better organization and conduct of accounts and the securing to carriers of the advantages that may be expected to follow the interchange of ideas between their representatives. Among other specific benefits, it is believed that an association will assist in securing more equitable means of determining balances between carriers and greater promptness in the payment of the same; that it will be the means of securing uniformity in the adjustment of joint accounts; that it will secure more prompt settlement of claims between carriers; that it will aid in breaking up the credit system at competing points; that it will be the means of improving present methods of adjusting balances at junctions where freight is rebilled; that, through its efforts, greater uniformity will be attained in the governmental returns required of railroads; that the free discussion and comparison it will engender will greatly enlarge the experience and understanding of those who belong to it, and thus be the means of securing more nearly perfect methods of accounting; and finally, that it will greatly benefit carriers in directions not possible to mention here, or likely to be attained, except through the aid of an association. And, as national boundary lines have no existence in the accounts of carriers, the committee are clearly of the opinion that the value of the association will be greatly enhanced by making it general in its scope. Also that it shall embrace steamship and other transportation companies having joint traffic relations of an intimate nature with railways."

Of the purposes of the Car Accountants' Association, a circular issued by its officers in 1886 said:—

"The object of this association is for the improvement of car accounts, and the promotion and advancement of car service in general. Recognizing the fact that 'in unity there is strength,' in 1876 a small band of car accountants organized an association, with Mr. H. T. Curd, of the Louisville and Nashville Railroad, as chairman, and Mr. F. L. Luce, of the Chicago and North-western Railway, as secretary. The association has steadily grown in numbers, as well as in favor, until it counts three-fourths of the roads and lines in the United States and Canada as its members. The good effects of this association have been felt everywhere. Car records have been simplified, a perfect system of car tracing has been introduced, enabling some roads to do away with lost-car agents, and last, but not least, a uniform rate of car mileage has been agreed upon which bids fair to give universal satisfaction. At our annual meetings a member of the association has the advantage of comparing his forms and of hearing expressed the practical experiences of car accountants from all portions of the United States and Canada. Certain important topics for discussion are arranged for by a committee before the annual meeting, and each member furnished with a copy, so that each can get the opinion of the manager of his road. Any member, however, has the right to introduce any subject bearing upon car accounts during the meeting of the association."

There are associations of railroad superintendents, of train dispatchers, of yard masters, of road masters, of railroad water superintendents, of railway chemists, of claim agents, of railway telegraph superintendents, of railway conductors, of railway station agents, of locomotive engineers, of firemen, of switchmen, and of several other classes of employés, and also railway clubs in several cities, in some of which there are interesting and instructive discussions of questions relating to the mechanical departments of railways.

The aims of a few of the bodies named above are chiefly the accomplishment of personal objects, such as the establishment of insurance funds, and creation of methods for securing concert of action in matters relating to pay, grievances, or strikes. Relief funds, and elaborate systems for creating and distributing them, have been established by some railway companies, acting in concert with their employés. One of the most prominent of the latter class of organizations is identified with a large portion of the Pennsylvania system, and another with the Baltimore and Ohio.

The general subject of the relations of companies with their employés may be materially affected, in a manner advantageous to both parties, by the establishment of relief funds of various descriptions, to which contributions are made by companies as well as the prospective or actual recipients of moneys appropriated, and this is one of the directions in which an improvement may reasonably be anticipated in all matters that have a bearing upon the probability of averting strikes, and securing reliable continuous service.

The utility of the various classes of associations of railway officials and employés naturally depends greatly upon the scope of their duties. The fact that such organizations have materially increased in number and influence during late years is one of the features of development which may gradually gain great importance. The proceedings of the bodies which are cordially supported by a large number of important railway companies have already led to the attainment of some highly important ends, a number of which have been described, and eventually they will presumably do much to promote a practical federation of all the steam railway companies of the continent for the attainment of sundry useful purposes. If the interstate-commerce act had legalized money pools, instead of prohibiting them, the various traffic associations would probably have done more to prevent undue discrimination against persons and localities than positive legislation is likely to accomplish, and they may promote a number of desirable ends, even if they are shorn of the powers that would most materially enhance their utility.

UTILITY OF EFFECTIVE METHODS OF ORGANIZING RAILWAY FORCES.

All railways that participate in interstate commerce are subject to the requirements of the interstate act, and the supervision of the interstate commission; the probabilities of congressional action on miscellaneous matters relating to railways have been increased by important initial steps in that direction; thirty-eight state legislatures and twenty-two state railway commissions have afforded abundant evidence of a disposition to embrace all convenient opportunities for displaying their wisdom in the regulation of numerous classes of railway affairs; a considerable portion of the business of federal, state, district, and county courts usually consists of the trial of railway cases, many of which represent unjust or extortionate claims against companies; hordes of speculators are continually occupied in adroit efforts to boom or depress American railway securities; a vast army of shippers is constantly endeavoring to secure the lowest attainable rates; countless travelers are patronizing, criticising, or condemning railway lines; and there is no class of intelligence to which wider publicity is given than news of accidents to passenger trains. There certainly seems to be no lack in the number of agencies for detecting railway faults or deficiencies; but the excess in quantity is more noticeable than superiority in quality.

To combat the formidable antagonistic and dangerous elements which must be confronted by American railways it is desirable that the best attainable forms of organization should be universally adopted. There are notable differences in existing methods, and it can scarcely be doubted that some of the systems are better than others, even if due allowances are made for all the differences in circumstances that affect such affairs. The general subject has presumably not received, in all quarters, as much attention as its importance deserves. It may be a matter of much greater consequence than appears upon the surface how and where power and responsibility are reposed. As a rule they should go hand in hand, that is to say, any class of officials who are made responsible for the discharge of certain duties should have sufficient power to ensure their proper performance. In applying this principle difficulties arise from various causes which lead to conflicting decisions. One of the most distinguished railway accounting officers of the country (M. M. Kirkman) announced a few years ago that $300,000,000 of railway revenue had been collected under his supervision without the loss of a single dollar, and this remarkable success was attributed to the fact that power to enforce rigid compliance with the rules necessary to secure prompt remittances had been exercised by the department entrusted with the collection of revenue, in contradistinction to systems under which laxity in making returns had been condoned. This statement illustrates one of various directions in which it is not improbable that some companies might find it advantageous to modify existing arrangements.

Of the general method of distributing or deputizing railway authority an address delivered at a convention of train dispatchers a few years ago said: "The stockholders in the first place surrender their control to a board of directors; the board of directors surrender it to the president; the president to the general manager; the general manager to division superintendents, who in turn divide their responsibility with the man next in charge of the transportation department, who is generally the chief train dispatcher or train master." Sundry qualifications of such a system relating to particular duties or responsibilities of special classes of employés may in some instances be found desirable.

ECONOMIC EFFECT OF ADVANCES FROM THE TRAIL TO THE T-RAIL.

On the tremendous difference in the available results of the use of horse-power, or its great successor, the locomotive, on roads of various classes, and on the fact that the world now has railways while formerly they did not exist, more than upon anything else, rests the edifice of modern civilization.

To secure to a considerable extent the benefits that may be derived from the higher classes of roads it is necessary that there should be a triumphant struggle with many gigantic adverse forces of nature, and also with subtle obstructive traits of mankind.

The real meaning of the existing state of transportation facilities, so far as they apply to freight movements, can perhaps be best shown by reference to the task of moving one ton one mile. That is the unit of many of the calculations and statistics bearing on this subject. Your ton of freight is a mile distant from the place where it would be useful to you. How shall it be removed? If there is nothing to facilitate the operation but your own stout arms, and your individual capacity as a burden-bearer, and you have no route better than an Indian trail, and no vehicle, you will be fortunate and more skillful or effective than the mass of mankind, if you can move that ton one mile in less time than a day and a half, exclusive of the time occupied in returning to the point of departure after you have deposited the largest load you can advantageously carry. Elaborate theoretical investigations and numerous practical experiments have demonstrated that when sturdy men are employed as burden-bearers, the greatest attainable amount of work is secured when they are loaded with 119 pounds, which well-trained men commonly carry eleven miles in one day, thus making a movement equivalent to the transportation of 1,309 pounds one mile in one day, and 1,963 pounds, or not quite a net ton, in a day and a half. If men carry a heavier load they will not move over so great a distance, and if they carry a lighter load they will lose more in quantity transported than they will gain in rapidity of movement. It follows that the money compensation for human labor, unaided, in attempting to carry through freight in competition with the average railway charges of the present day, would represent an average sum of less than two-thirds of a cent per day, even if loads in both directions were provided, and probably less than a half a cent per day if there was no back loading.

There are other results which may be worthy of attention, and perhaps one of the simplest ways of illustrating them is to indicate the difference in cost, or time and labor, by various transportation methods, of the movement of anthracite coal from the Schuylkill mines to Philadelphia for a distance, in round figures, of 100 miles.

Suppose that, for any reason, the head of a family was obliged to carry the coal upon his back from the mines to that city, and that his effective work was up to the average standard of moving 1,309 pounds one mile in one day, how long would it take him to move one ton 100 miles? If we suppose the ton to be a gross ton of 2,240 pounds, then the movement for 100 miles is equal to moving 224,000 pounds one mile. To make such a movement at the rate of 1,309 pounds in one day would require a little more than 171 working days, if no allowance is made for return journeys. But return journeys must be made, and as he carries only 119 pounds, the number of them would be a fraction more than 18, equivalent to walking 1,800 miles. If he walks 30 miles in a day on the return trips, 60 days would be consumed by them, and the time required for moving one ton of coal from the Schuylkill mines to Philadelphia, if the time for returning for each load is included, would be a little more than 231 days.

Such movements are necessarily so expensive that in practice they were rarely made, even during savage or colonial eras, except over very short routes. The usual method of transporting heavy and comparatively cheap articles over long distances, and indeed the only method for making such movements at a cost which did not exceed values at the point of consumption, was formerly by water routes, and it is only since the advanced railway era made lengthy land movements of cheap products possible that a new order of things, deeply affecting all persons and interests has been established.

But navigable water routes do not extend to all parts of the earth, and even under the most favorable circumstances land movements must, to some extent, be intermingled with water movements. The Indian system, and the system prevailing in this country during all the colonial era, and the first third of the present century, was founded on the use of water routes for all bulky and lengthy movements, intermingled with the resort to land carriage to such a limited extent that it was at best but little more than "making a portage," of various lengths, or transferring property from one water route to another.

As civilization advances, and numerous immigrants establish themselves in inland districts, the necessity of mitigating the horrors of the portage system is developed. Then roads are constructed; at first very poor ones, scarcely passable for vehicles at any season, and often impassable, but roads on which horses or other beasts of burden can be used to carry loads. This stage was very protracted in many portions of this country during colonial periods, and for some years later. What a horse can carry on his back often depends largely on the condition of roads, and especially on whether they are comparatively level or mountainous, abounding in steep grades. On roads of the latter class the loads formerly common were about 200 pounds, while on level roads they approached and occasionally exceeded 400 pounds.

If we suppose that horses can carry from 300 to 400 pounds, say 350 pounds, on their backs over long journeys, on roads interspersed with hills and dales in the usual proportion, and that they can continuously travel 20 miles per day, the result would be the equivalent of a movement of 7,000 pounds one mile in one day, a labor which would be worth, in competition with the average charges for all the freight railway movements of a recent year in this country, about 3½ cents. As horses could not be expected to make such movements without human superintendence, and as it was usual in organized pack-horse transportation systems to have one man to take charge of every ten or fifteen horses, some allowance should be made for such supervision. If we add to the work of fifteen horses the labor of one man, the combined result of a day's operations is equivalent to the movement of 105,000 pounds.

At this rate, one man and fifteen horses, could make a movement equivalent to the transportation of a ton of coal from the Schuylkill mines to Philadelphia in a little more than two days, if no allowance is made for return trips; but if they are reckoned the time required would probably be between three and four days. It is obvious that communities obliged to depend upon pack-horses for exchanges of merchandise would buy and sell very few bulky articles. It is stated that in 1784 the cost of transportation, by pack-horses, from Philadelphia to Erie, was $249 a ton—a movement that has since been made by rail for a small fraction of this sum.

The next step is the construction of common or country roads. Much may depend upon the character of the vehicles used, and still more, perhaps, upon the extent to which the road is improved. In interior Pennsylvania it was stated some years ago in a report of the canal commissioners that on ordinary poor and hilly country roads, a team moved one ton of freight 12 miles in one day, and that in the next stage of development, represented by the inferior turnpikes, the team moved 1½ tons 18 miles per day—the gain or increase being from the equivalent of 12 tons moved one mile to 27 tons moved one mile, an increase of 125 per cent., which was the reported benefit in Pennsylvania, of the substitution of turnpikes for common roads. The teams referred to were four-horse teams, each of which usually had a driver, and the weights drawn, of course, included the wagon on which freight was loaded. To secure the benefits of the turnpike, tolls were exacted which frequently exceeded the sums per ton per mile now charged by railway companies for the entire movement of such freight. On the first of American turnpikes leading between Philadelphia and Columbia, these tolls were at an early period at the rate of 1.35 cents per ton per mile. Omitting consideration of tolls, and looking only to results achieved on the turnpike, we have, as the product of the work of one man and four horses, in one day, the equivalent of a movement of 27 tons one mile, which is worth, according to the average modern railway standard, about 27 cents!

The business of moving freight in Conestoga wagons was, of course, never conducted at anything like such rates in this country. The sums actually paid on various routes have already been stated.

If we apply four-horse-team facilities to the movement of coal to Philadelphia from the Schuylkill region, the result would be that a ton could be taken there, over rough country roads, in a little more than eight days, and an equivalent amount of work could be done on a turnpike in a little less than four days. At the rate of 20 cents per ton per mile it would cost $20 to move a ton of coal from the Schuylkill mines to Philadelphia. The movement of one of the first wagon loads taken there in a wagon did cost $28.

The charges actually paid for land movements, as indicated by the statements already made, were so high that the surplus commercial value of many classes of cheap products now moved over lengthy overland routes was entirely consumed before they reached the point of consumption, or reduced to such small figures that there was no incentive to surplus production in many districts. Several results followed: First, that the gross amount of production was infinitesimal in comparison with the production of the present day, making due allowances for difference in population; second, that a large proportion of those who endeavored to create surplus supplies were obliged to perform more toilsome and persistent manual labor than is now common among men engaged in similar pursuits; and third, that expedients were adopted for reducing the bulk and weight of surplus products, such as transforming cereals into whisky, for instance, which are now unnecessary.

When we consider that the best results attained in Pennsylvania, by turnpike roads, in connection with the overland freight movements of considerable length, was so expensive or unproductive, that the commercial product of four horses, a Conestoga wagon, and a driver, was, according to modern standards, worth only 27 cents per day, we begin to see what a vital element of progress was furnished by the railways. It is only by great improvements on the early lines, however, that the present condition of affairs has been produced.

The effective force of a mule on the Mauch Chunk Railway, the early coal road of Pennsylvania, was equal to the transportation of a little more than 57 tons one mile in one day. This was a very crude railway; but the difference between the effective force of a mule on that line and a team of four horses on a crude turnpike, moving only 27 tons one mile in a day was very great; the work of four mules on the railway being 228 tons moved one mile in one day, or more than eight times the work of the corresponding number of horses on the turnpike. Some of the early horse railways were much better. On one of them the usual movement of one horse was equivalent to the movement of 240 tons one mile one day. The difference between the work of a horse on comparatively superior early railways, and the work of a mule on the Mauch Chunk Railway, is represented by the difference between 57 tons and 240 tons, moved one mile one day, or, in other words, the effective force of a horse on a railway was more than quadrupled by improvements in early railway construction.

Similar differences were subsequently developed in the capacity of steam railways, arising partly from improvements in locomotives but primarily from improvements in permanent way, inasmuch as the tracks of the first crude railways of this country were generally found to be too fragile to permit free movements of early locomotives which only weighed from six to seven tons; and such movements as are now made daily by heavy trains, if they had been at all possible, would soon have annihilated the superstructure of a number of the early lines.

The movements already described, as applied to the ton of coal to be moved one hundred miles, or from the Schuylkill mines to Philadelphia, briefly show about all that could be done to economize such movements before railways strong enough to support heavy locomotives were constructed, and before such locomotives were used. Let us recapitulate the results:—

1. To move one gross ton of coal 100 miles by a human burden bearer would require 231 days of labor.

2. To move one gross ton of coal 100 miles on a pack horse would probably require his services for a little more than 50 days, if allowance is made for return trips.

3. To make the movement over a rough country road would require the use of a team and four horses for a little more than 8 days, and on a turnpike road for a little less than 4 days, if no allowance is made for a return trip; but with such allowance the time would be materially increased.

4. On a crude railway, like the early Mauch Chunk coal road, a horse or mule could move 57 tons one mile one day. Such labors would be equivalent to carrying one ton of coal 100 miles in about 1¾ days.

5. If a superior railway for the use of horse power could be used and the appliances brought up to what was formerly considered a high standard for such works, and movements equivalent to 240 tons one mile in one day were made, the result would be the performance of labor equal to the movement of a ton of coal from Schuylkill mines to Philadelphia in less than half a day.

Then, with a horse railway of a high class, one horse, under such human guidance as might be found necessary, would, in less than half a day, perform a labor which would require 231 days of the work of a man as a burden bearer.

On all important railways there has been a rapid advance during late years, in the weight of locomotives, of trains, and the amount of freight carried. It is difficult to say what can be or is now accomplished. It is known that years ago trains containing from 500 to 700 tons of freight commenced passing over great lines, daily, sometimes over distances of 100 miles per day, and occasionally over double that distance. A movement of 500 tons for a distance of 200 miles in one day, means the equivalent of 100,000 tons moved one mile in one day, and this is not a difficult feat. At present a number of existing locomotives are capable of drawing more than 2,000 tons on a level railway.

Trains carrying an aggregate weight of 1,500 tons, including the weight of the engine and cars, are now not uncommon; and some trains are run over favorable grades which carry 1,500 tons of freight. That seems to be about the capacity which was, in 1885, regarded as something beyond a usual standard, and yet attainable. The weight of standard freight trains running from Mifflin to Harrisburg, on the Middle division of the Pennsylvania Railroad, in 1885, was 2,445 tons.

The locomotive and cars weighed 1,889,205 pounds, and the load weighed 3,000,000 pounds, or 1,500 net tons.

In connection with the low average railway rates of the present day it should be understood that all railway charges are by no means uniformly brought down to the lowest standards; and, also, that the approaches to the existing average rates have been gradual, the declines extending over a long series of years, and the possibility of making such reductions as have occurred being only gradually developed by many combinations of favorable circumstances and the pressure of intense competition. The most notable feature of all comprehensive railway statistics, relating to extensive transactions, and covering a series of years, is a marvelous increase in the volume of business, or number of tons moved one mile, and a contemporaneous decrease in the average charges for such movements.

The amount of labor performed on railways in the United States is now so great and the charges for much of it are so low that it was estimated by a government statistician of the Interior Department, that an equivalent amount of land transportation could not be obtained through any other agency than railways for a less cost than more than $11,000,000,000, while all the receipts of the railways were considerably less than $1,000,000,000; so that the aggregate annual saving effected by railways, in comparison with any other land agencies of transportation, is approximately $10,000,000,000, or a sum about equal to the value of all the products of the country, exclusive of duplications.

This statement gives such a comprehensive view of the magnitude and relative cheapness of railway labors that it may be desirable to state, more particularly, that the report of Carroll D. Wright, United States Commissioner of Labor, dated March 17th, 1886, says: "There are in the United States 28,600 locomotives. To do the work of these locomotives upon the existing common roads of the country and the equivalent of that which has been done upon the railroads the past year would require, in round numbers, 54,000,000 horses and 13,500,000 men. . . . The present cost of operating the railroads of the country with steam power is, in round numbers, $502,600,000 per annum; but to carry on the same amount of work with men and horses would cost the country $11,308,500,000."

LESSONS OF TRANSPORTATION DEVELOPMENT.

THE preceding pages represent an earnest effort to collect and present in a convenient form many of the facts bearing on the wonderful advancement of transportation systems in the United States.

There are two ways of reaching conclusions. One is to invent a theory and deny or ignore facts which demonstrate its fallacy. The other is to ascertain and study the facts, and base any definite opinions that may be formed strictly upon them.

The intelligent and disinterested reader will base any theory he may adopt on the facts, regardless of the efforts made from time to time to promulgate and enforce delusive, confusing, and contradictory views, or to apply, on a stupendous scale, false plans or principles of action. He will ask what are the causes of lamentable failures and of great successes? What is there to applaud and what should be condemned? What are the great lessons to be drawn from the logic of events and actual developments?

It is easier to ask such questions than to answer them, partly on account of a superabundance of complications which render it impossible to prescribe any single cure-all for either of many minor evils, or to suggest a universal style of progression applicable to all contingencies. The possibilities of making sundry things better or worse are almost as wide as the range of human effort, and it is idle to attempt to achieve all that is desirable by any small number or particular description of reformatory efforts.

Attention has already been directed to obvious lessons, some of which may again be referred to in a brief recapitulation:—

First. Numerous new illustrations have been afforded of the old truth that roads or other convenient channels of communication are the greatest aids of civilization and progress. The commercial, industrial, social, and in some respects even the moral and political conditions of a country are often controlled by the character of its available roads. There can be no genuine prosperity in large inland districts without good roads, a phrase which, at this day, means railways. Such an extraordinary movement of population from rural districts to towns and cities as has occurred during the last half century would have been impossible if existing facilities for the cheap and rapid movement of persons and property had not been provided. The mining, manufacturing, mechanical, and agricultural developments, which excite wonder and admiration, constantly contribute to the happiness of mankind, and form the vital essence of modern life, could not exist in the absence of the iron highways of the present day.

Second. Advancement was exceedingly rapid and effective in promoting desirable ends, after railway construction by incorporated companies fairly commenced, and exceedingly slow before the commercial principle was invoked. More is done now in a decade than was formerly done in centuries.

Third. Progression, through all its ramifications, hinged on a long series of gradual developments, one thing growing out of another, each successful step in a desirable direction being followed by more extensive movements of a similar character, intermingled with sundry changes or improvements; the essential feature of all positive gains being an improved application of scientific methods to the performance of the task of moving persons and property, as a substitute for primitive and inferior appliances.

Fourth. Transportation has become a science, and scientific knowledge of many matters affecting it, and the skillful application of scientific principles to each of many things, are vitally necessary to attain the best results. This great truth has too often been ignored, and to a disregard of it many disasters of numerous descriptions may be attributed. Damaging and dangerous errors in the performance of many classes of multitudinous and prodigious labors, from the highest to the lowest, both in construction and operation, can only be avoided, to the extent that is practicable and desirable, by a better recognition than has heretofore been universal, of scientific truths evolved from the plain teachings of experience. In comparatively simple affairs, such as tamping a tie, or firing a locomotive, it is difficult, on many roads, to secure the services of men who are willing and competent to perform their tasks in a reasonably correct and efficient manner. The constant losses suffered from their delinquencies are typical of things to be avoided in many broader fields of action, from the organization or operation of great railway lines to the passage of interstate-commerce bills.

Fifth. Scientific methods, whether they affect the construction of bridges, tunnels, or other portions of a railway, or the removal of obstructions to waterways, or the manufacture and operation of cars or locomotives, are necessarily expensive, and some of the most intricate and complicated of all transportation questions relate to the methods by which the enormous capital employed for such purposes shall be provided, and the owners of such capital compensated.

Sixth. It is unjust and unfortunate that while a large number of individuals, interests, sections, and communities have been greatly benefitted by the construction and operation of railroads, the total wealth of the country being increased by them to a much greater extent than their cost, a large proportion of the owners of American railway securities have suffered great losses from their investments in such property. Much of the capital applied to creating and operating lines which immensely benefited the persons served has been unremunerative. There are various causes for such losses, but so far as they are attributable to unwise or defective legislation, past errors should be avoided and amends made for wrong-doing. One of the great needs of the time is that the public conscience should be quickened in regard to the relations between governments and owners of railway property, and especially in reference to legislation relating to the capitalization of railway companies and the regulation of railway rates.

Seventh. Whatever may be done for the improvement of waterways or the construction of artificial water routes, they can only provide for a small portion of the requirements of the American people, and navigable rivers and canals must always have limited mileage and scope of possible utility, in comparison with the railway lines now existing.

Eighth. No results have been so satisfactory as those secured from the operation of solvent and prosperous railways, by an ample corps of reliable and skillful officials and well-trained employés. Impecuniosity or lack of available means to promptly provide the necessary or desirable improvements of permanent way and rolling stock, lead to the infliction of privations or injuries, in the nature of imperfect facilities or accommodations, damaging delays, and terrible accidents. It is, therefore, the interest of that portion of the public which is not directly concerned as investors, as well as of the holders of securities, that railway operations should be attended with a reasonable degree of financial success.

Ninth. Experience has indicated, in connection with the operation of the gigantic railway systems which now conduct a large proportion of the transportation movements of the United States, that there is greater danger of their bankruptcy, and of the wasteful and unnecessary duplication of lines, than of systematic overcharging. Competition has been so much encouraged by a variety of causes, that manifest evils have grown out of its excesses, and while the people of many sections are likely to enjoy all the benefits that can arise from it, there are a number of directions in which protection from its injurious outgrowths is desirable.

Tenth. While few things are more useful and beneficial than the construction of a railway where it is really needed, few things are more wasteful or a more prolific source of widespread misfortunes than the construction of unnecessary lines, or roads for which there is not sufficient use to render them remunerative within a reasonable time after they are finished.

Eleventh. Railways represent the first effort to combine the functions of owners of extensive highways with the duties of common carriers. The labors involved in both these capacities have been performed in a manner so far superior to pre-existing methods, in economy and effectiveness, that the total amount of transportation now conducted immensely exceeds the volume of corresponding movements in former times, and the freight and passenger business of hundreds of lines has increased, from year to year, with wonderful rapidity, a result that could only be achieved by rendering useful and desirable service to many millions of persons. The bulk of this service is performed by incorporated companies, whose principal incentive to exertion is a desire to secure remuneration for the capital represented by their stock and bonds. Failure to obtain given sums renders them unable to pay their just debts or to make adequate returns to their stockholders, and imposes on them perils of bankruptcy, which are often seriously felt by owners and creditors as well as the communities served; and when such disasters are unusually numerous they injuriously affect the entire industrial and financial system of the country.

Twelfth. Wherever the railway goes it is accompanied with three other things of great importance. They are the mail, telegraph, and express. Immense districts have been supplied with these pioneers and adjuncts of civilization, commerce, and intelligence by the extension of railways. The huge masses of mail matter and enormous editions of daily newspapers forwarded could not be moved with the rapidity necessary to meet current requirements by any other agencies than those which now perform this task. The express system has grown up with railway expansion, from small beginnings into stupendous proportions.

Thirteenth. That the general welfare would be promoted by keeping railways on a commercial footing can scarcely be doubted. An assumption of governmental control of railways accompanied with the assumption of pecuniary responsibility for the result of their operation would be a hazardous experiment, and those who wish to maintain the solvency and freedom of the Republic may well contemplate it with horror. The greatest real danger of such a perilous resort comes from injustice practiced by American governments in their relations to railways.

Fourteenth. Ample opportunities have been afforded of judging of the actual results in the past, and probable results in the future, of reliance for transportation facilities upon the governmental action which has provided common roads, improved rivers and harbors, and built a few canals and railways; and upon the action of incorporated companies which furnished nearly all the turnpikes, canals, and railways. The difference between the condition of the country if governmental efforts alone had been made, and that now existing, may be more readily imagined than described. The wisest thing governments have ever done in connection with this subject was to authorize companies to make and operate the steel rivers of internal commerce; and the wisest thing they can do in the future is to judiciously blend an avoidance of officious intermeddling with an honest discharge of their legitimate duties to railway investors, travelers, and transporters.

THE END.

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