RAILWAY CROSSINGS IN EUROPE AND AMERICA.

BY FRANKLIN B. LOCKE.

IMPORTANCE AND SIGNIFICANCE OF THE SUBJECT.

NO more vexed question presents itself in many of our American cities to-day than that of grade-crossings. The vast property interests, both private and corporate, which are affected by any proposed change; the extensive systems of competing railroads, with their established terminals; the interests of the public as represented by the municipality, are all elements that enter into the problem, and must all be considered in any attempt at a solution of the difficulties involved.

The abolition of the grade-crossings means, properly, the separation of street and railway grades; the adoption of such arrangements at stations as will prevent, as far as possible, the crossing of the tracks by passengers; and also the prevention of all persons, except those connected with the railways, from entering upon the tracks, or crossing them, except at certain prescribed places where crossings are allowed. These are the principles which underlie the practice in Great Britain and Germany, and all legislation upon the subject has in view the attainment of these results, as far as possible. In a large measure the same may be said of other European countries, although Great Britain and Germany stand easily first in these matters.

IMPROVED CROSSINGS GIVE BETTER SERVICE.

THE traveler from the West who journeys throughout England by rail does not realize the degree of perfection which has been attained there in these particulars. While he is annoyed by the lack of certain conveniences to which he has been accustomed, he fails to notice the high and very uniform rate of speed at which his train travels through innumerable cities and to the very heart of London, and always apparently regardless of the network of streets and other railways which cross and recross the line upon which he is traveling. The system by which the city traffic is admirably separated from the railways in Liverpool or Birmingham or London does not particularly interest our tourist from America while he is complaining of the cold and the lack of freedom that he is compelled to endure.

An average of the fast express-train time on these roads for fifty-four trains daily, up to and down from London, is about forty-six miles per hour. This showing cannot be equaled by the service rendered by the railways of any other country in the world.

The facility and rapidity with which trains are handled and business is despatched in the many cities throughout Great Britain and Germany, where grade-crossings do not exist, should be mentioned as largely compensating for the expenditures involved. In the case of the Great Eastern Station in London, seven to eight hundred trains a day are successfully handled, and the facilities have been recently increased to provide for a thousand trains in twenty-four hours. The number of passengers transported yearly to and from this station is about fifty-five millions, which is more than equal to the passenger business of all the roads entering the city of Boston. The Great Eastern passes under Shoreditch and other important streets in the immediate vicinity of the station, and, farther away, passes to an elevated system. What is true of the Great Eastern is true of other great stations in London. At Cannon street, not to choose an extreme case, the trains average about one every minute for several hours in the morning and for several hours in the evening.

HYDRAULIC POWER IN GREAT BRITAIN.

HYDRAULIC power is a very important factor in the operation of the railroad terminals in Great Britain. In the passenger stations, for the handling of express and baggage, its use is very common; but in its application to the handling of freight it has a most important bearing upon our subject. It affords the one practicable means of loading and unloading and shifting in the depressed and elevated terminals. The cars must be raised or lowered from the regular track-level to the street-level, and this is accomplished by means of car-lifts operated by hydraulic power. At the street-level the cars are loaded and unloaded by hydraulic cranes, and

are then sent to the proper level, and despatched to their destinations. By an arrangement of capstans, turn-tables, and transfer-tables, all run by the same power, all shifting and making up of cars is successfully and very economically performed. About eleven years ago the writer inspected the systems at the stations of Glasgow, Liverpool, London, and Paris; and these same plants are still doing duty in a satisfactory manner. The ends accomplished by their adoption are threefold: it solves the difficulties of the double-level stations; it affords the means for doing a very large amount of business within a small space; and it is also claimed that the cost of handling goods is less than half the cost of handling the same amount of business at our surface terminals in America. A considerable portion of this difference of cost, however, is certainly chargeable to the difference in the cost of labor.

QUESTIONS OF ECONOMY AND COMPETITION.

IN connection with the question of economy, it may be proper to note that in both Great Britain and Germany the estimated average returns upon the capital invested in railways is greater than is the case in America. A direct comparison is, of course, almost impossible, owing to the different methods of handling the railway finances in the different countries. It is nevertheless significant that in these countries, where the returns upon invested capital are necessarily small, there should still appear to be an advantage in their favor; and this fact should lead us to inquire whether their large expenditures have not been wise from a financial standpoint, and whether, to any considerable extent, the same principles should apply in our own cities.

The policy of the foreign companies, which has led them to provide every facility for handling their suburban traffic with the greatest possible despatch, also to push their lines as near to the centers of business as possible, has discouraged the construction of competing lines of street-railroads, and has otherwise, of course, tended to increase largely the traffic of the steam-lines. That the opposite policy has been pursued by many American companies, under the belief that the first cost of providing the improved facilities was too great, has undoubtedly retarded the growth of business, and encouraged the wholesale construction of electric and other species of street-railroads, which attempt to give the rapid transit that should be given by the steam-roads. We have, therefore, in the street-railroad system a phase of grade-crossing difficulties destined to increase in annoyance as the traffic increases.

A COMPARISON OF CASUALTIES.

WITH the casualties that are properly classified as due to grade-crossings are generally included accidents to trespassers—that is, to persons who attempt to cross or walk at grade upon the lines between the prescribed crossings. This class of accidents forms a large factor in the sum total of deaths and injuries, and great care is taken by the foreign companies to protect the public in this particular. Fully one third of all the accidents to persons on the English roads belong to this class; and while it is generally regarded that these accidents are the result of carelessness on the part of those who take the risks of entering upon the lines, it is nevertheless noticeable that no reasonable precautions are neglected. In America, as a whole, scarcely any provision is made for preventing this class of accidents. In the State of Massachusetts alone there are about half as many deaths from this cause as in the whole of Great Britain and Ireland; and during the last fifteen years nearly one half of all the fatalities upon the railways in that State have been of this class. By averaging the fatalities occurring in Great Britain and Germany, and comparing with the average for Massachusetts and Connecticut, the proportion is about as seven to one in favor of the foreign countries. Certain classes of accidents are now almost unknown in Germany. Accidents to pedestrians at road-crossings, or to passengers from crossing the tracks at stations, are hardly possible at the present time. Any one attempting to walk upon the track is sure to be stopped, and very severe penalties are imposed for any defiance of the orders of an employee.

In this connection, a few broad comparisons are very significant. In the city of Buffalo, for instance, it was reported, a few years ago, that sixty-one fatalities occurred at grade-crossings in eighteen months, being two more than the number reported for the whole of Germany for the previous five years. Again, in the report of the Terminal Commission to the Mayor and Common Council of Chicago, it was stated that over two hundred people lost their lives at the grade-crossings in that city in 1891. This is nearly as many fatalities as occurred in the whole

of Great Britain and Ireland from the same cause during the succeeding five years. These figures seem to indicate that these two cities afford from three to five times as many fatalities of this class as the whole of Great Britain and Ireland and Germany combined.

PRECAUTIONS IN GREAT BRITAIN.

GENERALLY speaking, the objections to grade-crossings were clearly foreseen in England, and the remedies were applied in the cities when the railways were established. In the country districts there are still a considerable number of grade-crossings. They are by no means so numerous, however, as on the Continental lines. Under the regulation of Railways Acts, 1868 and 1871, a penalty of forty shillings is provided for the offense of entering or being upon a railway, except for the purpose of crossing the same at some authorized crossing. It is provided, however, that the offending party shall first have been warned by the agents of the company. This latter fact somewhat reduces the efficiency of the regulation, as it is often difficult to give satisfactory proof of warning. The Board of Trade have made regulations and recommendations as to the arrangements at stations, and regarding the protection of grade-crossings where they exist. Platforms are to be not less than three feet above rail-level, except in rare instances. Each passenger track is to have its separate platform, and stress is laid upon the principle that passengers should find it difficult, and always unnecessary, to descend upon the tracks. The character of gates, and the manner of operating them, are prescribed. Private road-crossings are also provided with gates; and under the law of 1845 a penalty is provided for persons who neglect to close them after passing through, and persons using them enter upon the track at their own risk. The comparative freedom from accidents of all classes on the English roads is due to much investigation by parliamentary commissions, many of the reports by these commissions being very suggestive and valuable. Among other tangible results of these investigations has been a wise extension, in 1871, of the powers of the Railway Department of the Board of Trade. Since that time, and largely through the efforts of the board, there has been a marked decrease in railway casualties throughout Great Britain, as indicated by the statistics covering these matters.

THE EXPERIENCE OF GERMANY.

IN Germany grade-crossings were originally permitted. There was an average of something over one and a half grade-crossings per mile of standard-gage railway in Germany in 1892. Under the direction of the government, the changes that have been undertaken in remedying these conditions have revolutionized the railway systems in nearly all the cities of Germany. New stations and viaducts are among the most important works that have been carried out in the empire during the last fifteen years. Owing to the fact that many of the details of original railway construction in Germany were widely different from the practice in Great Britain, different conditions had subsequently to be met, and a broad policy was undertaken by the German government in meeting and overcoming the features that were considered unfavorable. The railways in Germany have been gradually absorbed by the government, until now only a small proportion of them are operated by private corporations. In a general way, the conditions to be met there relative to grade-crossings were similar to the conditions existing in America at the present time. Their station arrangements were similar. Passengers were frequently obliged to cross the tracks in order to reach their trains. They have the low platform, about ten inches above the top of the rail, rendering it an easy matter to descend to the tracks. And formerly there existed a prejudice against the adoption of elevated stations, subways, and overhead bridges. It is therefore interesting to know that, as necessity has required the introduction of these features, public sentiment has veered round and recognizes their desirability. The various accidents which occurred at stations, etc., contributed to this end. These were naturally of more frequent occurrence under the old system, and culminated in a calamity at Steglitz, near Berlin, where a crowd, while crossing the tracks in attempting to board a local train for Berlin, was run down by an express, resulting in the death of thirty-seven persons. Before the accident, a petition for the reconstruction of this station, providing for undergrade crossings by means of subways, had been rejected in the House of Deputies, on the ground of expense and the objections to tunnels, etc. After the accident, the work of reconstruction was executed substantially as originally planned, with subway and with suitable platforms provided with a strong fence between the main tracks.

The street near the station, which formerly crossed the tracks at grade, was at the same time carried under the tracks.

The larger portion of the expenditures which have been incurred in Germany in abolishing the grade-crossings has been in the cities. Modern stations and elevated tracks are to be found throughout the empire. It is there well understood that any attempt to deal with the subject by providing for the isolated crossings and leaving the city streets untouched, simply perpetuates the worst phase of the difficulty. The expenditures have, accordingly, been large, and the results proportionately so. The magnitude of the work at Cologne may be suggested by the fact that $5,900,000 were voted for this purpose by the Prussian House of Deputies as long ago as 1883. Construction began in 1885, and the cost as originally estimated was increased to about $7,600,000. In the execution of this work the street grade-crossings are avoided by the elevation of the tracks, although this requirement was in some instances carried out with much difficulty. The six tracks of that portion of the line which lies within the old fortifications are carried upon a viaduct, while beyond them the tracks are upon embankments. The magnificent main station building is located upon the site of the old building, close to the cathedral. In this station are embodied the most approved features of the modern station. The principles that passengers must not be allowed to cross the tracks, and also that baggage and mail shall not be handled by crossing the tracks, or through the same passageways that are devoted to passengers, are all we can note in this connection. The expense of these large constructions has generally been borne by the government, while in England the expense incurred in avoiding or abolishing grade-crossings is generally borne by the railway company. The cities have very rarely shared in the expense, and are held only to the same share in the maintenance as before the change took place. It will be seen that the foreign roads, in their various stages of development, have been held very strictly to an observance of the rights of the public. If there is any discrimination, it is in favor of the public.

FACTS FROM OTHER COUNTRIES.

WHAT has been said relative to the railways of Great Britain and Germany applies in a measure to France and other Continental countries. There are, however, not the same inducements in some of these countries for making great changes, in the way of modernizing the railway systems, that there are in those countries which we have been especially considering. The increase in population, and consequent growth of cities, is not so great; there is not the same effort to attain high speeds; and the traffic is in most cases comparatively light. There is always, however, very thorough construction. Grade-crossings in the larger cities are rare, and the guarding and policing of the railway properties are excellent. In the mountain districts of Switzerland, France, and Italy the writer found that the regulations were not so rigidly enforced. The trains, however, were comparatively few and of low speed. A considerable portion of the St. Gotthard line was examined, as were also portions of the Paris, Lyons, and Mediterranean Railway in the mountain districts, and generally no difficulty was encountered. In central Italy, and in other localities where trains are more frequent and the population living adjacent to the lines more numerous, permits were necessary in order to enter upon the railway-lines. Any attempt to do so without authority was always met with a prompt, though courteous, reminder that such a proceeding was in violation of the rules.

THE DEVELOPMENT OF SUBURBAN TRAFFIC.

AMERICAN corporations have been very enterprising in extending their lines into new districts—often, it must be added, where there was little business to warrant such extensions. Without questioning the wisdom of these enterprises, it may nevertheless be said that there has been, in most instances, a failure on the part of these corporations to secure to themselves the enormous local and suburban business which has grown up in and around our great cities. A great number of cases can be cited where this business is handled successfully and profitably on a large scale by the steam-roads of Europe, establishing beyond question the desirability of the service that can be secured in this way. American managers, however, have not only disregarded this business, but have actually discouraged it; and it is only within a few years that a proper appreciation of its importance and value has been shown by even a very few of the leading companies. There is, on the other hand, an almost total lack, on the part of the public, of any proper appreciation of the part which the existing lines terminating in or passing through the great cities should take in the development of this local and suburban traffic. Corpora-

tions have been allowed, and even encouraged, to withdraw their freight and passenger stations to points farther from the business centers; and, with very few exceptions, there has never been any effort, on the part of either city or State governments, to take such action as would lead to any development in the line above suggested.

INTERDEPENDENCE OF CITIES AND RAILWAYS.

THE principle that the cities and the railroads are dependent upon each other should never be lost sight of. In our modern civilization each is equally dependent upon the other for its existence, and there is every reason for coöperation between the railroad companies and the cities upon all questions wherein they have common interests. It seems safe to say that their interests are identical in numerous instances where there seems to exist only antagonism. Nearly every large city in the United States, in its efforts to obtain transit facilities, has been ready to give away valuable franchises to street-railroad corporations, at the same time neglecting the fact that coöperation with the existing roads may, in many instances, be the means of providing, in the very highest degree, the service which is really worthy the name of rapid transit.

RAPID TRANSIT IN BOSTON.

IN the city of Boston the indifference of the steam-roads to the suburban traffic during past years has turned that business largely into other channels. In the year 1896 the street railways of Boston handled above one hundred and sixty-six million passengers, or more than three times the number of both through and local passengers handled by all the steam-roads together. From 1881 to 1891 the steam-roads increased the number of passengers handled from about twenty-five millions to fifty-one millions. During the years from 1891 to 1897 the increase was only about two millions, while there was actually a decrease of about three millions from 1893 to 1897. The street railways, during the five years following 1891, increased their traffic by about thirty millions, showing an enormous increase of traffic for these railways, while the steam-railroads have in this particular made no progress, or have actually retrograded.

It has been held that a wise development of the steam-roads, extending them into the suburban territory and to the business centers,—providing, moreover, the rapid local service which the situation warrants,—would in a large measure have preserved the suburban business to the controlling companies. Such a system, together with the service that would still be performed by the surface cars, would provide Boston with an almost ideal system of rapid transit. The attempt by the street railways to handle this enormous traffic resulted in a congested condition of the business regions so great that action on the part of the municipality was finally compelled. As a result, the Boston Transit Commission, acting under legislative acts of 1894 and subsequent years, has nearly completed the Boston subway. When this work is finished, it will remove the difficulties due to congested railway traffic from those portions of Tremont, Boylston, Hanover, and other streets under which the subway passes. This very notable work is the pioneer of its class in this country, and certainly solves for Boston, throughout its length of nearly two miles, a very vexatious phase of grade-crossing difficulties.

It does not necessarily follow that where railroads are carried into or through the thickly settled portions of cities the same power shall be used within city and suburban limits for local service as for other portions of the lines. The use of electricity under such circumstances is not regarded as difficult of attainment. Even with steam as a motive power, it is possible to reduce the smoke nuisance materially by means of devices now in use. Such a system, involving the present railroads, is not only what the city of Boston needs, but it is the fundamental necessity of every large city. In the absence of some such development of the steam-roads, other systems are destined to flourish, not only within the city and suburban limits, but for paralleling the present lines in all directions.

STATE ACTION CONCERNING GRADE-CROSSINGS.

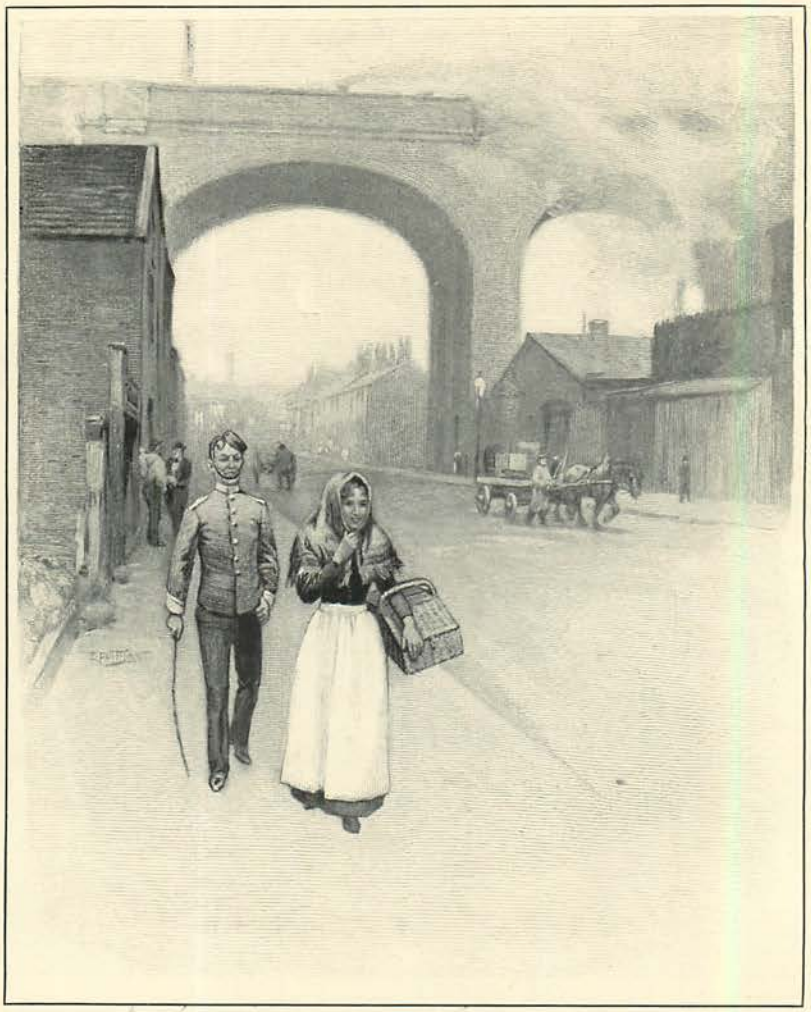
SEVERAL of the States have passed laws facilitating the elimination of grade-crossings; but generally the railroads have been left to the exercise of their own judgment in these matters. The Massachusetts legislature in 1888 passed an act by which a commission was appointed by the governor to investigate and report upon the subject of the gradual abolition of the crossing of highways by railroads at grade. As a result of the report made by this commission, and of the general agitation, the law to promote the abolition of grade-crossings was enacted. This law (Chapter 428, Acts of 1890) provides, together with its amendments, that upon the

petition of the authorities of a town or city in which a public way and a railroad cross at grade, or of the directors of the railroad company, or of the attorney-general of the commonwealth, acting upon instructions of the governor and council, the superior court may appoint a commission of three disinterested persons. The members of this commission are empowered to decide if action is necessary to prescribe the manner of making the alterations, and may also determine which party shall do the work. The act provides that the railroad companies shall pay sixty-five per cent. of the total actual cost of the alterations. The remaining thirty-five per cent. of the cost the commissioners are to apportion between the town or city and the commonwealth. Not more than ten per cent. of such cost can be apportioned to the city or town. The commission returns its finding into the superior court, and, if confirmed by the court, it becomes final. Further provision is made for the taking of land, the maintenance of the crossings after completion, and also that the amount to be paid by the commonwealth during any one year shall not exceed five hundred thousand dollars, and the total amount to be paid by the commonwealth shall not exceed five million dollars. In the case of new construction, no grade-crossings of public roads and railroads can be established without the consent of the railroad commissioners. Their consent, or the consent of a special commission, must also be obtained for the crossing at grade of electric and steam roads. In these particulars the board has of late years strenuously opposed the creation of new grade-crossings in the commonwealth.

In other States these subjects have received much attention; and it is to be regretted that in some cases the failure to pass laws facilitating these operations is due to the opposition of some of the strongest railroad corporations in the country. In the State of Connecticut much has been done in the way of favorable legislation. The State of Michigan has a law, enacted in 1893, whereby is established a board, entitled the Railroad and Street-crossing Board, consisting of two members appointed by the governor, together with the railroad commissioner, who constitutes the third member. The New York State Board of Railroad Commissioners secured in 1897 the passage of an act promoting the prevention of new grade-crossings, and the gradual abolition of those then existing. This act, similar in many respects to the Massachusetts law, constitutes the Railroad Commissioners as the board of appeal. As such their powers are similar to those of the special commis-

DRAWN BY E. POTTHAST.

VIADUCT OF THE LONDON AND SOUTHWESTERN RAILWAY OVER THE WESTMINSTER BRIDGE ROAD, LONDON.



DRAWN BY E. FOTHMAST.

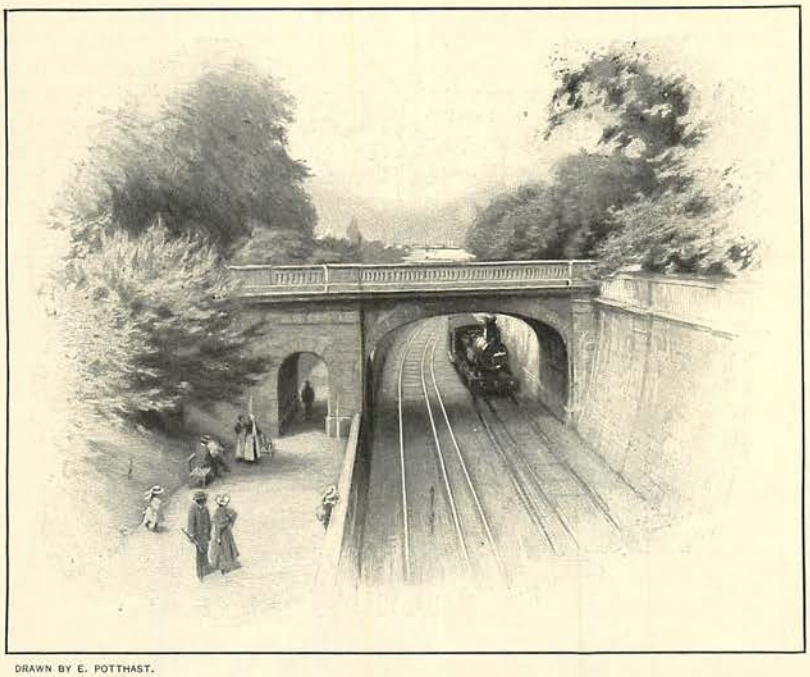
GREAT WESTERN RAILWAY VIADUCT, BIRMINGHAM.

sioners in Massachusetts. Owing to the opposition of leading railroads the desired legislation in the state of New York was long delayed. The proposed assessment against the corporations of sixty-five per centum of the costs of abolition was held to be too much, and, as the law now stands, one half the total cost is borne by the railroad and one half is equally divided between the municipality or town and the state.

IMPROVEMENTS IN MASSACHUSETTS.

SEVERAL of the corporations operating lines within the State of Massachusetts speedily availed themselves of the law of 1890, and along the main lines the improvements are numerous, and the character of the construction is of a high order. On the fifty-four-mile section of the Boston and Albany Railroad, between the cities of Worcester and Springfield, along which are located several thriving and important towns, the grades of the highways and the railroads have all been separated, and the work of elimination is being prosecuted along other portions of the line. These improvements have, in some cases, been executed in connection with the reconstruction of stations and the extension of other facilities. This company has not adopted the principle of preventing passengers from crossing its tracks at its more important stations, and this fact has been unfavorably commented upon by the State commissioners, and regretted by others who desire to see the introduction upon the railroads of the commonwealth of all ideas conducive in any way to safety, or to a higher uniform rate of speed for express-train service.

Outside of the work that has been done under the law of 1890, there have been several special acts passed by the Massachusetts legislature, under which extensive works of improvement have been undertaken. For instance, on the Boston and Providence division of the New York, New Haven, and Hartford Railroad the tracks have been elevated, in Boston, between Chester Park (now Massachusetts Avenue) and Mount Hope Station, a distance of about four and a half miles, thereby freeing of all grade-crossings a section of about eleven miles in length, extending southerly from the Park Square Station in Boston. In the case of this improvement, which is estimated to cost about two million dollars, the State pays thirty-one and a half per cent., the city thirteen and a half per cent., and the railroad fifty-five per cent., of the total cost. The cities of Brockton, upon the same system, and Newton, on the Boston and Albany, have also secured, through the passage of special acts, the abolition of the grade-crossings in each of those cities. More or less work has been done upon nearly all the other lines in the State.



DRAWN BY E. POTTHAST.

GREAT WESTERN RAILWAY, BATH, ENGLAND. PASSING THROUGH THE SYDNEY GARDENS.

THE NEW VIADUCT IN NEW YORK CITY.

In Connecticut and New York the work done upon the line of the New York, New Haven, and Hartford Railroad is of great importance, and the beneficial results are to be recognized in improved service and in greater safety. To these improvements is due, in a large measure, the fact that this line affords the fastest long run in New England. The time between New York and Boston is now five hours, or about 46.6 miles per hour, including stops at Providence, New London, and New Haven. This compares favorably with the fast trains in America or in England; and as the projected improvements are carried out, not only as to the abolition of highway grade-crossings, but as to modernizing the stations and reducing grades and curvature, this company will be abundantly able to render service of a very high order between the two cities. The very notable work recently completed in New York city contributes materially to this end. The improvement consists of the elevation of the four tracks along Fourth Avenue, between 110th street and the Harlem River, by means of a steel viaduct; then over the river by means of a new four-track bridge; and finally descending from the north end of the bridge by viaduct and embankment to the former grade at Mott Haven Junction at 149th street. This section accommodates the traffic of the New York Central and Hudson River Railroad, the New York, New Haven, and Hart-

ford Railroad, and the New York and Harlem Railroad as it passes to and from the Grand Central Station at 42d street. This traffic constitutes above five hundred train-movements in twenty-four hours, and is handled with facility and increased rapidity since the completion of the new work. Moreover, about a mile of Fourth Avenue south of the Harlem is given its full width of one hundred and ten feet, and, the new bridge being twenty-four feet above high-tide water, the delays at the draw are far less frequent than was the case with the old low-level bridge.

IMPROVEMENTS IN OTHER STATES.

OTHER lines terminating in New York have made equal advances, the elevated terminals at Jersey City and at Philadelphia being models of elevated stations and terminal lines which at once settle the question of the adaptability of these methods for American cities. At Detroit, the Canadian Pacific, the Flint and Père Marquette, the Wabash, and the Detroit, Lansing, and Northern railroads, all obtain entrance over an elevated structure to the new Fort Street Union Depot. This depot is conveniently located near the principal business center, and is a fair example of those cases where terminals have been brought from remote to more central locations. At this station is a hydraulic plant for handling the city freight; there is one at Cincinnati, and another at the Pennsylvania Railroad terminal at Philadelphia. These constitute the principal examples of this system thus far established in America. In Philadelphia the business of the Pennsylvania Company over its elevated terminal increased from 7,801,525 passengers in 1884 to 17,277,891 in 1892. During the year 1893 the new Reading terminal was opened, the extension of the tracks to 12th and Market streets being upon an elevated structure of the most substantial character, by means of which the Reading lines are brought virtually to the center of the city.

AN INSTANCE FROM THE CHICAGO EXPOSITION.

IN this connection, the work of the Illinois Central Company in raising its tracks and providing improved facilities in Chicago is particularly interesting. It is the general policy of this company to prevent passengers from entering upon its tracks at stations, highway crossings, or upon the right of way, wherever it is practicable to do so. While

DRAWN BY E. POTTHAST.

FOOT-BRIDGE, MIDLAND RAILWAY, SUTTON-IN-ASHFIELD.

DRAWN BY MALCOLM FRASER.

CEINTURE RAILWAY, AT THE BOULEVARD VICTOR, PARIS.

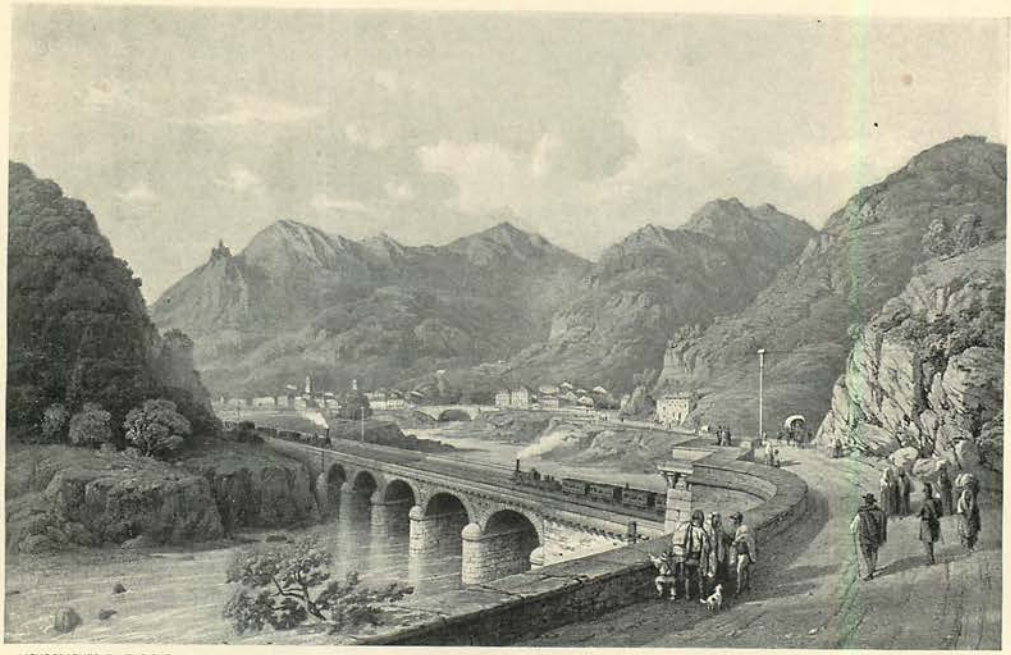
there are a large number of highways and other railroads crossing their lines at grade, the creation of new crossings is now strenuously opposed in the case of new lines or of new highways.

The terminal lines of the Illinois Central, in the city of Chicago, north of Grand Crossing, for a distance of 9.56 miles consist of eight tracks: two tracks for local suburban service, with stations approximately one half-mile apart, two tracks for through passenger service, two tracks for through freight service, and two tracks for high-speed express suburban service.

During 1892 these eight tracks were elevated from 47th street to 71st street, so as to admit of all the streets in this district, which were the approaches to Jackson Park (at which point the World's Columbian Exposition was located), being carried under the tracks. Inside the city and suburban limits, express, suburban, and through trains run at speeds varying from forty to fifty miles an hour with perfect safety. The line is fenced, turnstiles are used to prevent trespassing upon the tracks, and high platforms, level with the floors of the coaches, facilitate the movements of passengers.

By the elimination of grade-crossings on the Illinois Central terminal, that company was enabled to handle during the six months of the Exposition nineteen and a half millions of people, without the loss of a life.

In this case there was a keen appreciation of the importance of the suburban traffic, and of the fact that this business properly belongs to the roads the franchises of which have been given for the purpose of accomplishing this work in the manner that shall be most satisfactory to the public. No commentary is necessary to show how these improvements have been of the utmost advantage, not only to the Illinois Central Company, but also to the city of Chicago. The city, however, had no share in the expense of building the eight-track structure, the burden falling principally upon the railroad. About twenty per cent. of the cost (the total being approximately four hundred thousand dollars per mile) was borne by the Columbian Exposition Company, the elevation of these tracks being of vital importance to the success of the Fair; and



LITHOGRAPHED BY T. PICKEN, FROM DRAWING BY C. BOSSOLI. DAY & SON, LONDON.

BRIDGE OVER THE SCRIVIA, ITALY.

about four per cent. of the total cost was paid by the surface cable line, that company being interested to extend its line on 63d street under the elevated tracks of the Illinois Central Road, avoiding in that way a crossing at grade.

THE QUESTION OF EXPENSE IN CHICAGO.

A HISTORY of the agitation in the city of Chicago engendered by the attempts to compel the railroads to elevate their tracks or otherwise abolish the grade-crossings, would be very voluminous. Investigations of a very comprehensive nature have been made, and repeated ordinances have been passed by the city government ordering the roads to take action in the matter. Arrests of railroad officials have repeatedly been made upon the occasion of accidents at the crossings, the city seeking to place the responsibility for these accidents upon the corporations. It has until recently been the position of the city that the railroads should pay the entire expense of elevating the tracks, including the depression of the streets, and damages to abutters along the railroad lines, etc. More recently, however, the city has undertaken, for a consideration of one hundred thousand dollars, to pay the damages to abutters on the lines of the Rock Island and Lake Shore roads, which are now elevated in compliance with city ordinances. Other lines are making serious preparations to follow the example of the Illinois Central and the Rock Island and Lake Shore systems. The attempt of the municipal authorities of Chicago to compel the wholesale elevation of all the railroads in the city, at the sole expense of the corporations operating them, led these corporations seriously to consider the advisability of moving their terminal stations outside of the city. Such a course would have shown how vitally the interests of the city and the railroads are united. Even the possibility of such a proceeding induced the city authorities to pursue a less radical course.

A THREE-LEVEL CROSSING.

ON the lines of the Pennsylvania Railroad many stations have been built, outside the large terminals, upon modern principles. Owing to their methods of operating a four-track system (the two outside tracks being for passenger-trains, and the two inside for freight-trains), they are enabled, in many cases, to provide against the necessity of passengers crossing the tracks at all, without the use of intermediate platforms, or spreading the tracks at the stations.

At Elizabeth, New Jersey, an important and very interesting piece of track and street

separation was accomplished. At the crossing of Broad street, North Broad street, East Broad street, and Morris Avenue, or rather at the junction of these several streets, occurs also the crossing of the Pennsylvania Railroad and the Central Railroad of New Jersey. These railroads and streets formerly all crossed at the same grade. It all constituted one of the worst and most dangerous crossings in the United States. The street traffic was heavy, and that on the railroads consisted of between five and six hundred trains per day. In the solution of this case the streets were depressed, and now pass under the Central Railroad of New Jersey, which remains at its former grade, while the Pennsylvania tracks were raised sufficiently to pass over both the streets and the Central Railroad, thus making a three-level crossing at this point—a rare thing in this country, though common in England. Several other grade-crossings were abolished at the same time, the Pennsylvania tracks being elevated for the entire distance through the settled portion of the city. New stations are to accommodate the passenger business, and these are of the modern type, thereby effectually doing away with the crossings on the tracks at the stations, as well as on the streets. These cases that have been mentioned are only samples of a considerable number of important works which have been carried out in America, all tending to show the adaptability of these principles to our general conditions.

ROOM FOR IMPROVEMENT.

As a result of a careful study of what has been done in Europe, and of our own system, one is compelled to believe, so far as the subjects under discussion are concerned, that the principles upon which most of our roads were originally constructed are unsatisfactory and soon to be discredited. No systematic attempt was made originally so to build the lines, even in the larger cities, that the streets should not be obstructed by the railroads, or *vice versa*. We have innumerable grade-crossings in both cities and country, a large proportion of which are not protected at all; and, moreover, there exists an utter lack of police or other regulation calculated to inspire in the public a proper respect for the property rights of the railroads, or for the dangers incident to the reckless trespassing so common throughout the United States. We have no adequate system for protecting grade-crossings, the ordinary gate, consisting of a single bar, which is lowered at each side of the tracks upon the approach of

LITHOGRAPHED BY T. PICKEN, FROM DRAWING BY C. BOSSOLI. DAY & SON, LONDON.

VIADUCT NEAR GENOA.

trains, being in many cases insufficient to prevent accident. Massachusetts, for instance, has between twenty-one and twenty-two hundred grade-crossings of highways and railroads. Of these about one half are protected by gates, flagmen, or bells, and one half are unprotected. The fatalities, however, at the protected crossings are nearly half of all the casualties occurring at both protected and unprotected crossings.

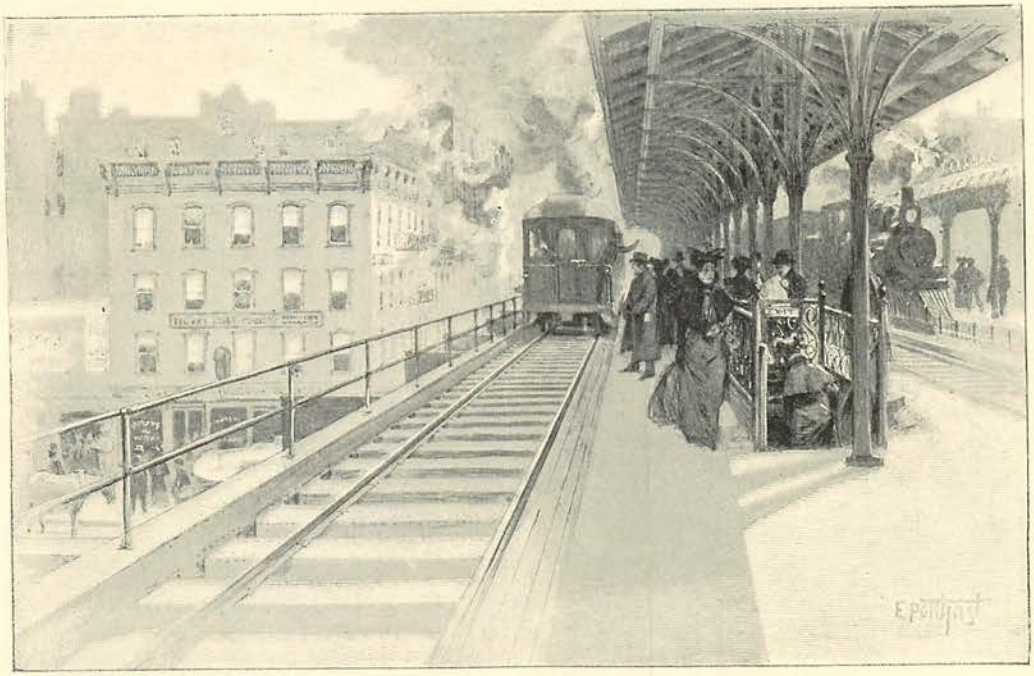
By far the most objectionable feature that marks our system in this connection, and is now being perpetuated to a greater extent than ever before, is the multiplication of the crossings of the steam-roads by the various forms of street-railroads, the growth of which is now so rapidly on the increase. A highway grade-crossing becomes a far greater source of danger the moment an electric or other form of street-railroad becomes a fixture in the street and crosses the railroad at grade.

WILL THE ABOLITION OF GRADE-CROSSINGS PAY?

A REVIEW of foreign practice as regards grade-crossings compels the encouraging belief that the expense of the works of improvement is not so great as to imperil the sound financial condition of the railways, but has rather added to their prosperity by adding to their facilities for handling larger volumes of business, and with greater economy. The railways of Great Britain have cost about $114,000 per thousand of population, while those of the State of Massachusetts, for instance, have cost about $70,000 per thousand of population. Should the principal highway grade-crossings in that State be abolished, basing the cost upon the estimate of the Grade-Crossing Commission appointed in 1888, which amounted to $40,766,000, the expenditure upon the railways of the State would still be inside of $90,000 per thousand of population. Judging from these figures, it is only fair to conclude that the population and wealth of at least the more thickly settled of the Eastern States will warrant the expenditure of considerable money in the interest of desired improvements. That abroad there are no difficulties in the way of handling freight and passenger business, on either an elevated or a depressed system, in a manner that has proved satisfactory to the most exacting public demands, naturally inspires the hope that equal success may be achieved

DRAWN BY ERIC PAPE.

CEINTURE RAILWAY OF PARIS, NEAR THE AUTEUIL STATION.



DRAWN BY E. POTTHAST.

NEW YORK CENTRAL RAILWAY AT 125TH STREET, NEW YORK CITY.

here, and that the advantages following the adoption of these systems may become the rule rather than the exception. That we are now suffering from the disadvantages of a system which must be eventually discredited, there seems to be no lack of evidence. For several years we have boasted of having the fastest train in the world; but if we compare the average time of the twenty-six fastest trains to and from New York on all of its twenty-six important roads, we get only about forty miles an hour, against the average, as we have already noted, of forty-six miles an hour for fifty-four trains running to and from London. If we examine the New England roads, it appears that of the twenty-four fast trains running to and from Boston the average speed is thirty-two miles an hour.

There is no reason to suppose that the English roads could attain a higher average speed for their express-trains than would be the case with us, were our conditions as favorable. Our comparatively low average is due, not to any failure to equip trains for high speeds, but to those features of the permanent way which place the limit at which trains can be run with reasonable safety. So long as those features are retained we lose in a measure the benefit of other refinements for the attainment of high speeds. It is interesting to notice that the American roads which have been most successful in giving the best express-train service are the roads that have, of their own volition, made large expenditures in remodeling their stations, and in raising or depressing their tracks.

Those roads that have been foremost in their efforts to provide the fast service demanded by the public have been the first to see the necessity of improved facilities, and they have moved in advance of the public and in advance of any compelling legislation.

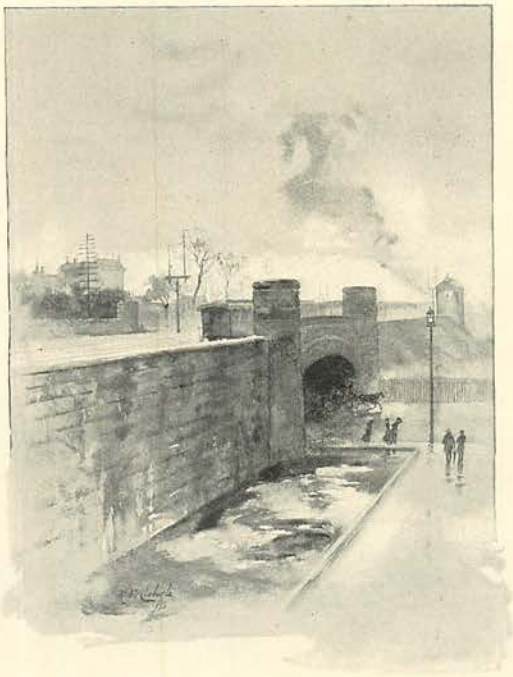
The very large expenditure necessarily involved in the reconstruction of the roads and terminals within the limits of our various cities renders the subject of the largest importance from a financial point of view. In the case of the foreign cities, the expenses were largely for extensions that would have had to be made anyhow, without regard to the question of crossings. The crossings and terminals and the extensions have all been considered together, upon the broadest principles. All the railways entering a city have generally been considered in all the cases where extensive changes were contemplated. Piecemeal work is to be avoided, and when extensions of railway terminals or large constructions are contemplated, the question of the effect of such proposed works upon a

DRAWN BY E. POTTHAST.

GARDEN STREET CROSSING, WORCESTER, MASSACHUSETTS.

city's streets, and upon the city at large, is of the greatest importance.

In America the theory of "hardship upon the railways" is accepted as a reason for delay in carrying out desired improvements; but if we can judge from the policy of the foreign companies, improvements of the nature that we are discussing are a benefit rather than a hardship, and it is perhaps not too much to believe that the American companies will show the same readiness in carrying out these improvements that we have remarked in the case of the foreign companies. The American people, while surpassing the world in the matter of accepting with complacency the facilities, good or bad, which the railroads see fit to give them, are nevertheless in many localities expressing themselves so clearly that their indifference or objection to proposed changes cannot be urged as an excuse for delay. It is to be hoped that as the sentiment of the public changes, a change of policy on the part of the companies will follow, and that our railroads will fast begin to rank as equal to any in the world in these particulars, as they already do in most other essential features.



DRAWN BY H. D. NICHOLS.

MAIN STREET ARCH, SPRINGFIELD, MASSACHUSETTS.

THE SEVEN WONDERS OF THE WORLD.[1]

BY BENJAMIN IDE WHEELER.

WITH A PICTURE BY ANDRÉ CASTAIGNE.

THE GREAT PYRAMIDS OF EGYPT.

OF all the structures included in any of the lists of the Seven Wonders, the Pyramids of Gizeh are the only ones left standing in our day. They are, too, of all by far the oldest. At the date when tradition assigns Moses to the service of Pharaoh they were already monuments of a hoary past. Fifty generations of men, perhaps a hundred, had already passed beneath their shadow. Already they belonged to a past and forgotten world, another Egypt, of which they were the lonely monuments.

Standing as they do to-day, the only living samples of the ancient wonders, they constitute a measure of the ancient marveling, and it is significant that they are as much a wonder now as they have ever been. They still rank with the most colossal monuments ever reared by the hand of man; but that is not all. Never have speculation and fancy, the handmaids of wonder, busied themselves so much and so variously with the problems of their construction and their purpose as in these latter days. Within the present century they have been interpreted, now as parts of a system of barriers against the shifting desert sands, now as parts of a mechanism for filtering the Nile water, or as monuments to the deluge, or means of rescuing by embodying in stone the mathematical and mystical lore of the world from an impending deluge, or as an embodiment of such measures as the distance of the sun, the circumference of the earth, the sacred cubit, or the planetary distances. An Oxford professor of Newton's time even wrote a book to demonstrate the antiquity of the English weights and measures from their agreement with the standards used in the construction of the Pyramids. To others they have served as monuments to primitive monotheism,

[1] See previous article in THE CENTURY for April, 1898.