The Beautifying of Highway Bridges

Increased Attention Given to this Subject following Activity in Road Work in Recent Years—Hints on Aesthetic Bridge Design

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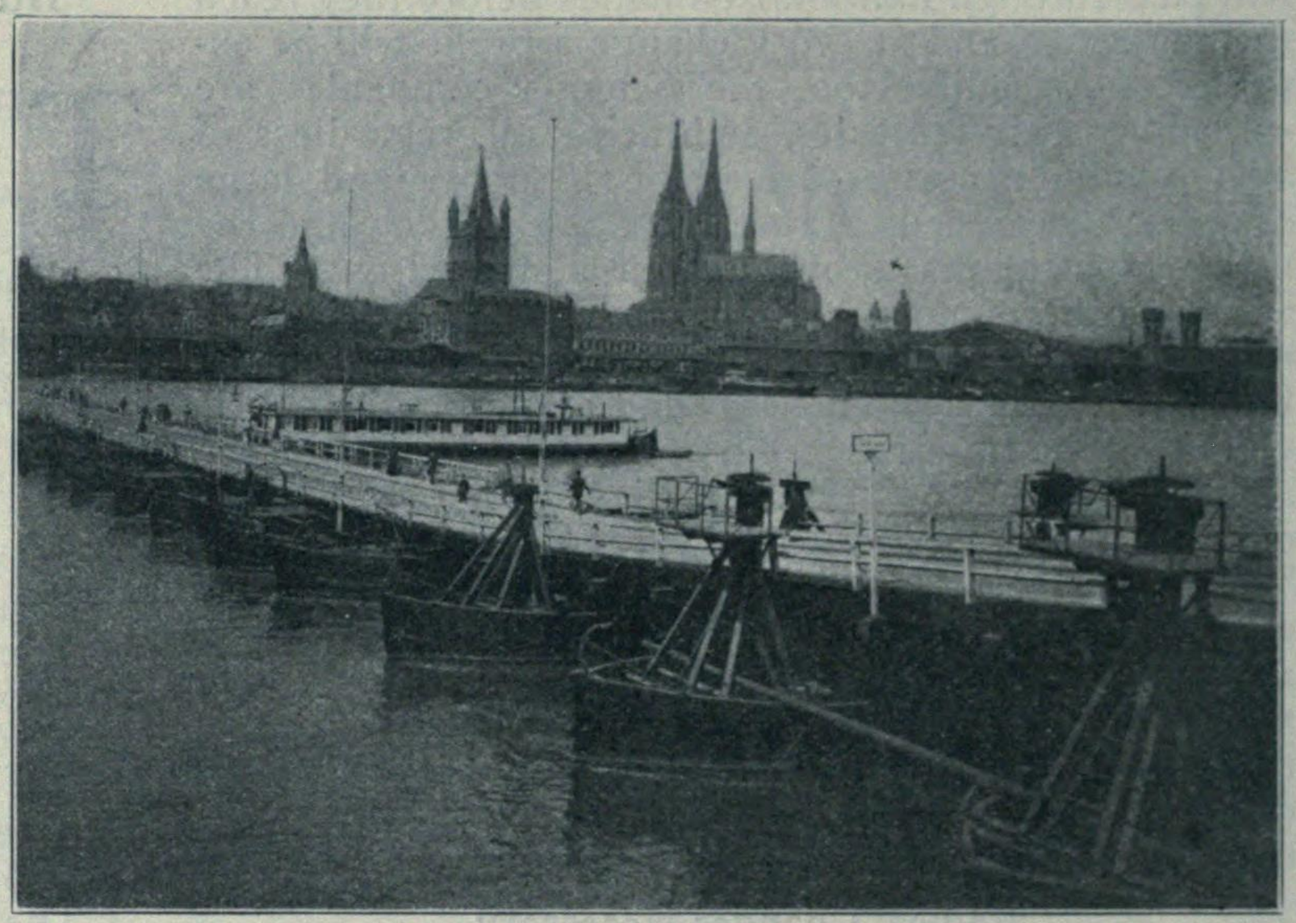
HIGHWAY bridges, even in the rural districts, are coming to have a greater claim on public attention, owing to the general impetus in road-building and extension. In the following paragraphs some rules are therefore given as a guidance in aesthetic bridge design, most of them being based on Tyrrell's Artistic Bridge Design, and Tyrrell's History of Bridge Engineering.

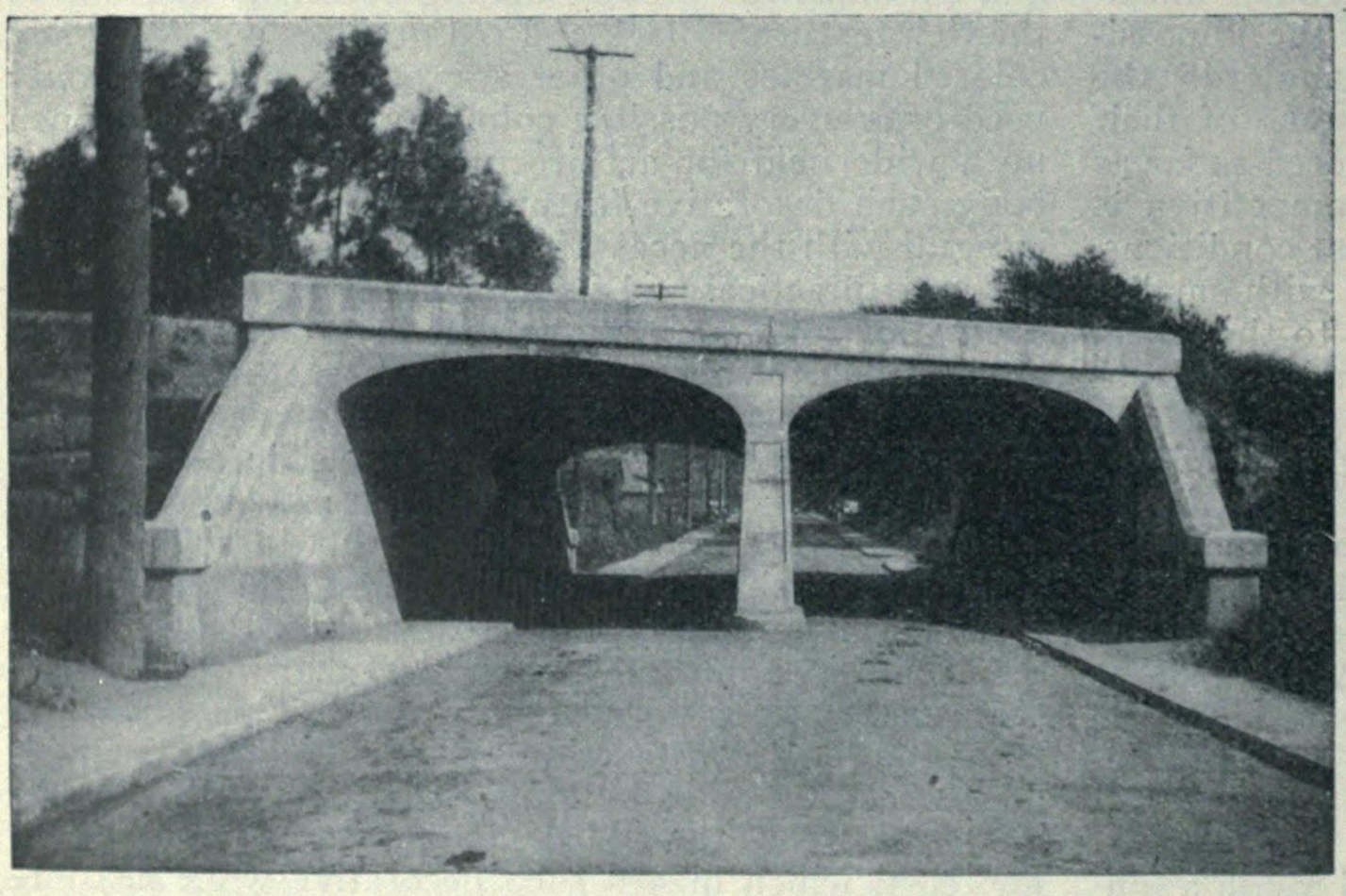
Taste for the beautiful depends on environment, and the character, culture and education of a people are frequently revealed in their constructions. Those who live in primitive and rustic surroundings usually have their aesthetic taste less highly developed than their more favoured brothers in the vicinity of educational centres. Unfortunately, fashion often influences in constructive matters as in other things, and the prevailing fashion in bridge building, in America at least, is the unsightly framed truss with gaunt and awkward outline. This type is fortunately no longer necessary, for certain rules of aesthetic design have recently been developed and established which but few engineers have yet had the time or the inclination to investigate. Their application to steel framing has heretofore received little attention in America.

The blending of different materials in a single structure is often difficult, but in the little park bridge at Madison, N.J., designed by the writer a few years ago, the blending was so arranged that the general effect is harmonious. The centre span is a steel arch, while the abutments are rough-faced stone work and the steps concrete. It is located in a city park over two lines of railway and is surrounded with plants and shrubs, making the effect quite pleasing.

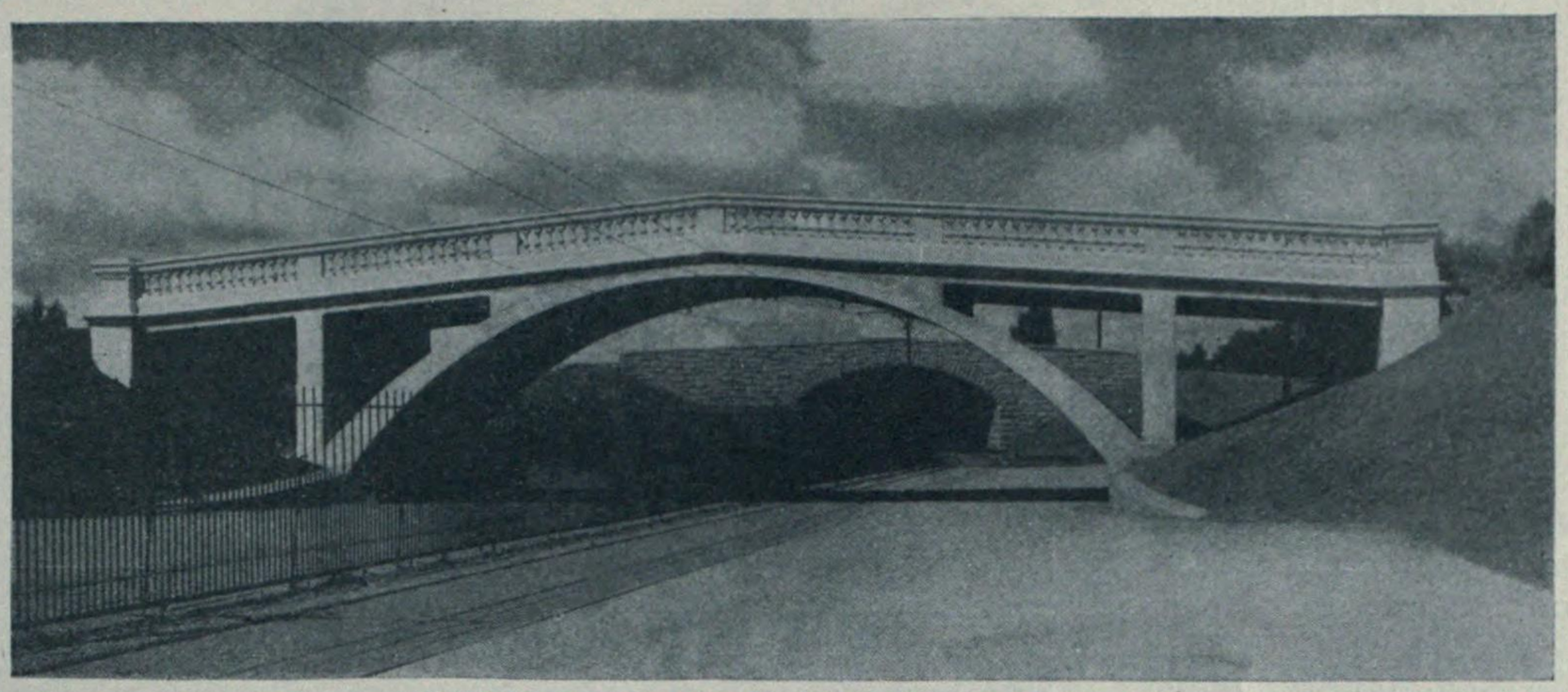


Pontoon bridge over the Rhine at Cologne. More attractive than an unsightly one of steel.

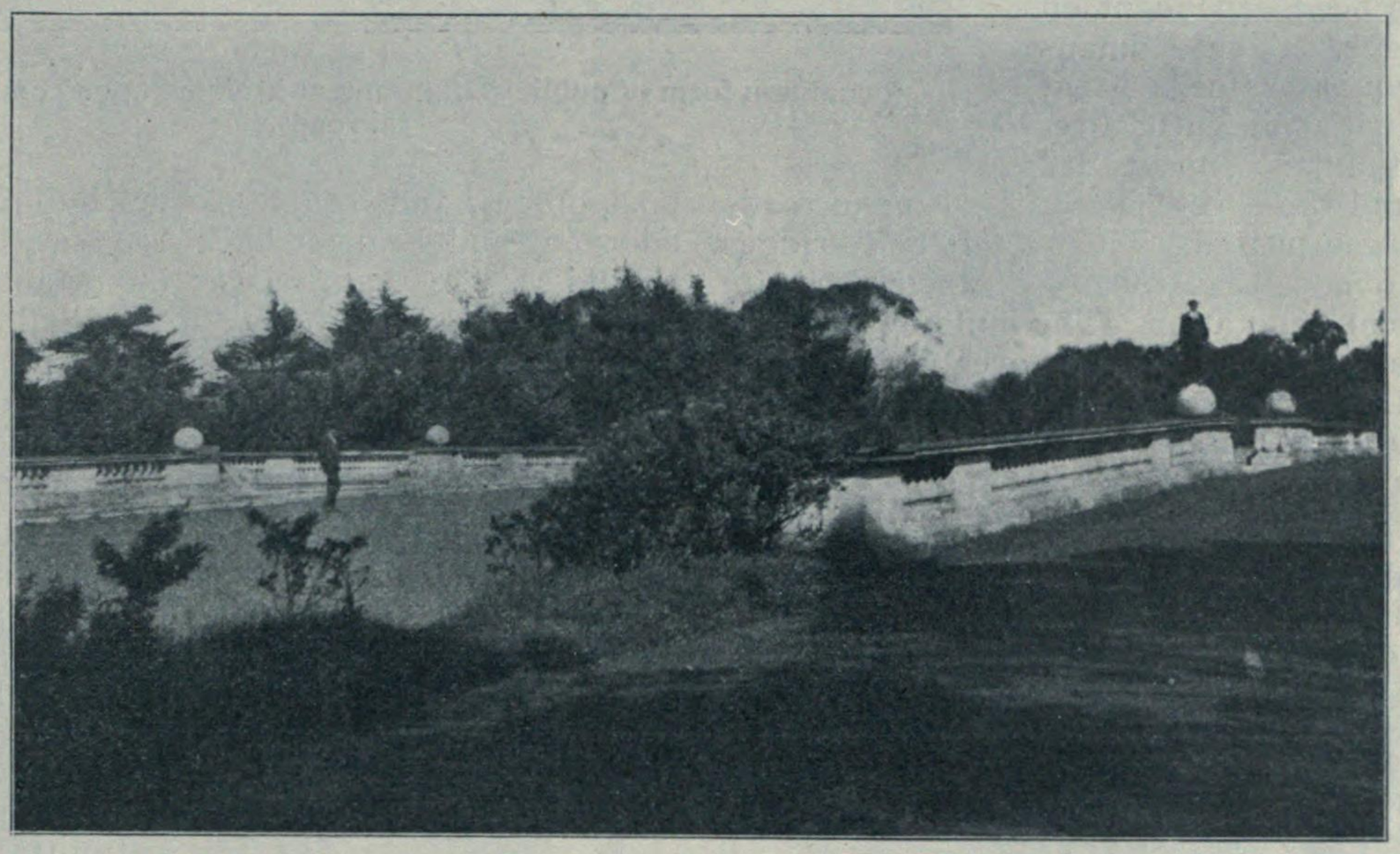
The condition and character of bridges, roads and other public utilities have been measures of civilization in all ages. The homeless savage in trackless wilds had little need for bridges, as his wants were few and achievements small. But as civilization dawned, human needs increased and the desire for greater comforts, better homes and surroundings, created a need for transportation and communication. The bridge of fallen logs or swinging vines gave place to better and more commodious ones over which loaded animals and carts could pass in safety. With the further advance of civilization and the extension of commerce, heavier and better bridges were required until the coming of railroad transportation in the nineteenth century, when stronger ones were erected to carry trains of cars and locomotives. The earliest bridges, like houses and other structures, were for utility only, and little or no thought was given to their adornment. Primitive races were content with homes which merely sheltered them from the storm and with rude bridges which served only their barest needs, but succeeding generations produced buildings in which utility was combined with art. But while houses have been adorned and made architecturally attractive, the beautifying of bridges has not advanced in proportion to other arts. Many cities which have splendid buildings, streets and parks, are disfigured with utilitarian bridges, wholly void of art and worthy of existence only in remote regions. The



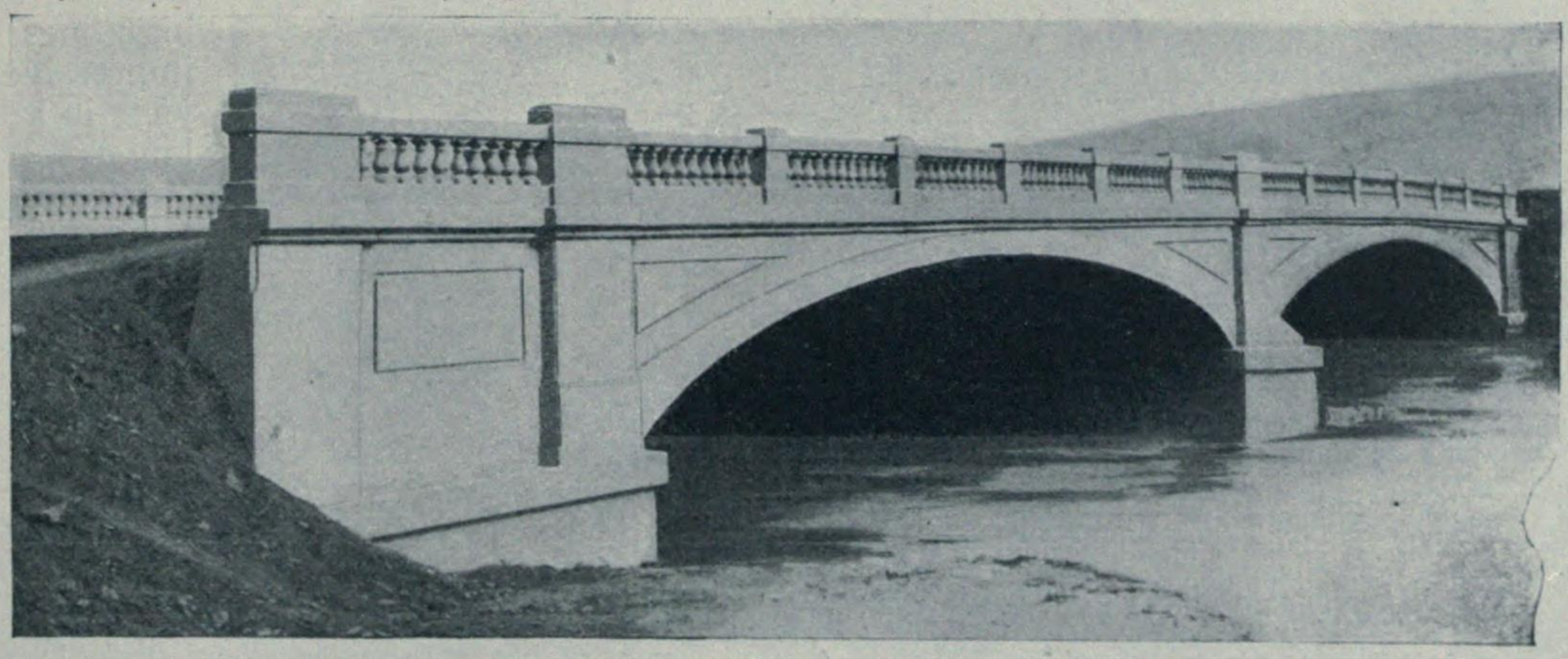
Curved wing walls and balustrades with terminal ornaments would have greatly improved this design.



Bridge at entrance to Como Park, St. Paul.



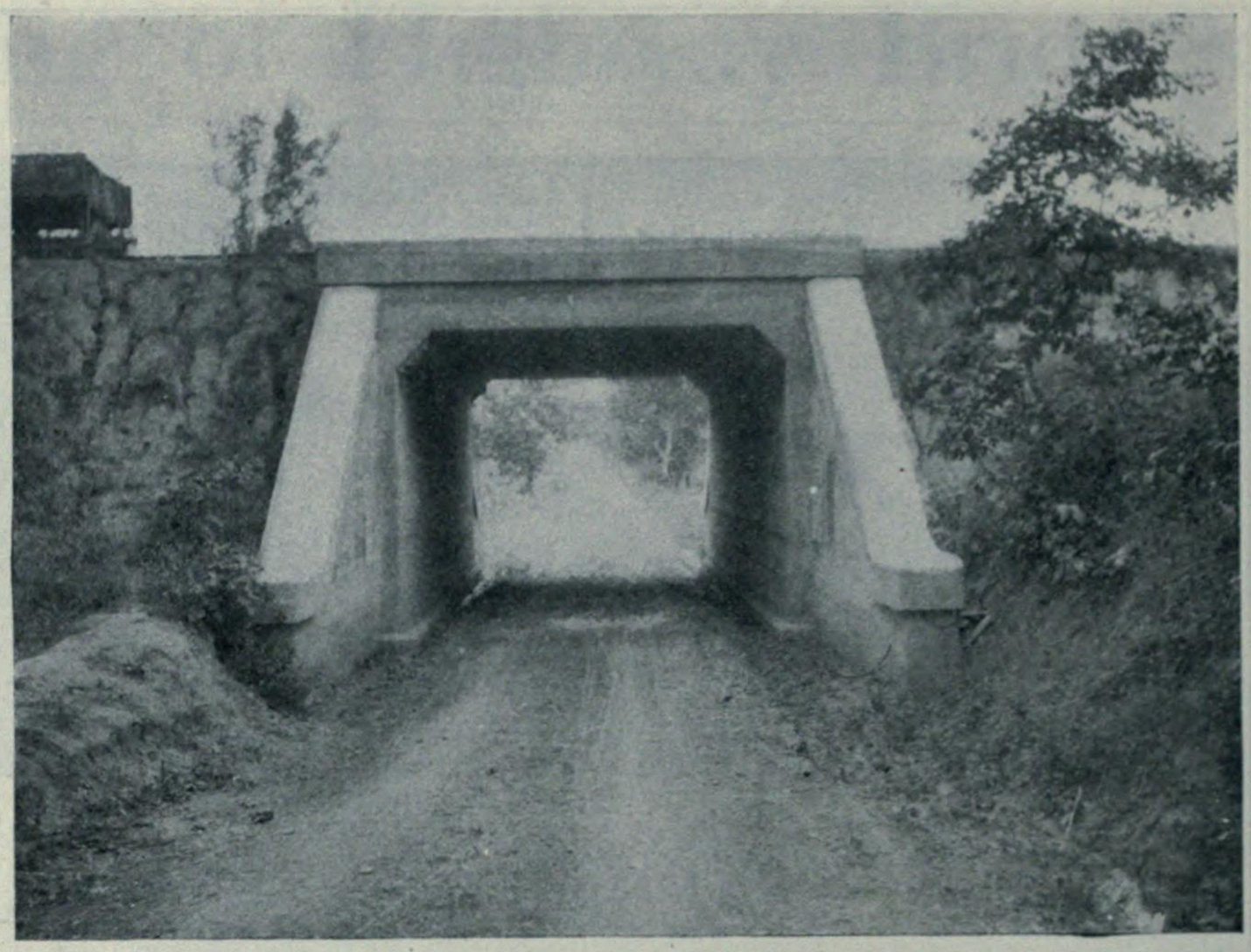
Bridge in Golden Gate Park, San Francisco. The view shows the ornamental balustrades.



A two span concrete bridge with ornamental balustrade.

greatest lack of art in bridges is found in America and other new countries where the need of rapid construction has prevented aesthetic treatment.

Great bridges are a distinctive feature of modern cities, and according as they are attractive or not they influence public estimation of the place where they are located. The beautiful bridges of Paris, Berlin and Budapest are of enough interest in themselves to attract travellers to those cities, and the bridges over the Rhine are among the principal features of the region. The bridges of these cities, and others, such as New York and London, are more conspicuous, especially from the water, than all their great buildings which have cost untold millions.

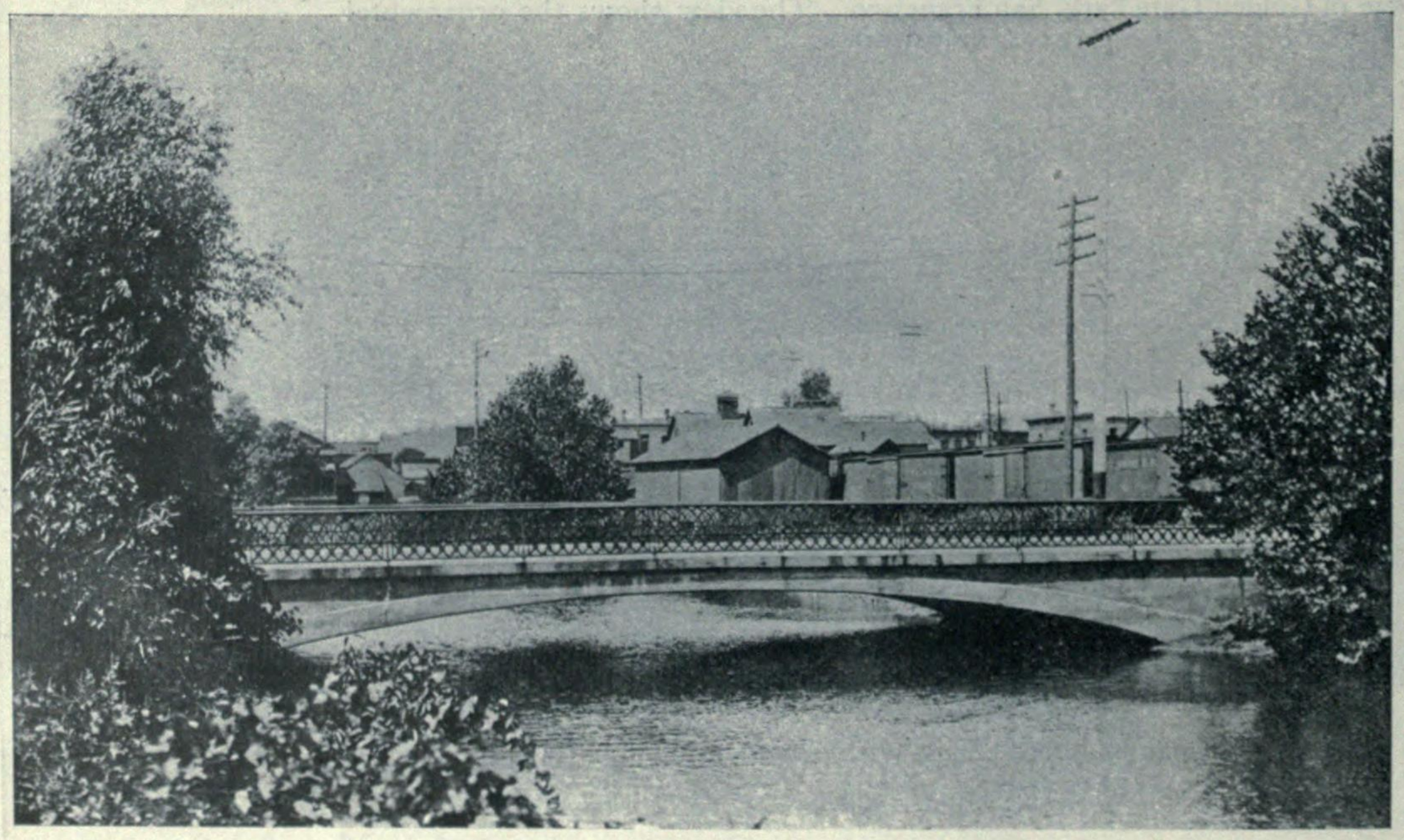


A common form of public disfigurement inflicted upon communities by the railroads.

The founding and building of empires has always been dependent on roads and bridges. The Romans saw that the requisites for a great nation were a fertile soil, natural resources and abundant means of transportation, and the excellence of the Roman roads has scarcely been surpassed. Their roads and bridges have endured for more than twenty centuries and are used by the present generation. The building of roads and bridges, therefore, has been the greatest factor in the development of nations and empires, and the condition of these utilities has always been a measure of their civilization and greatness.

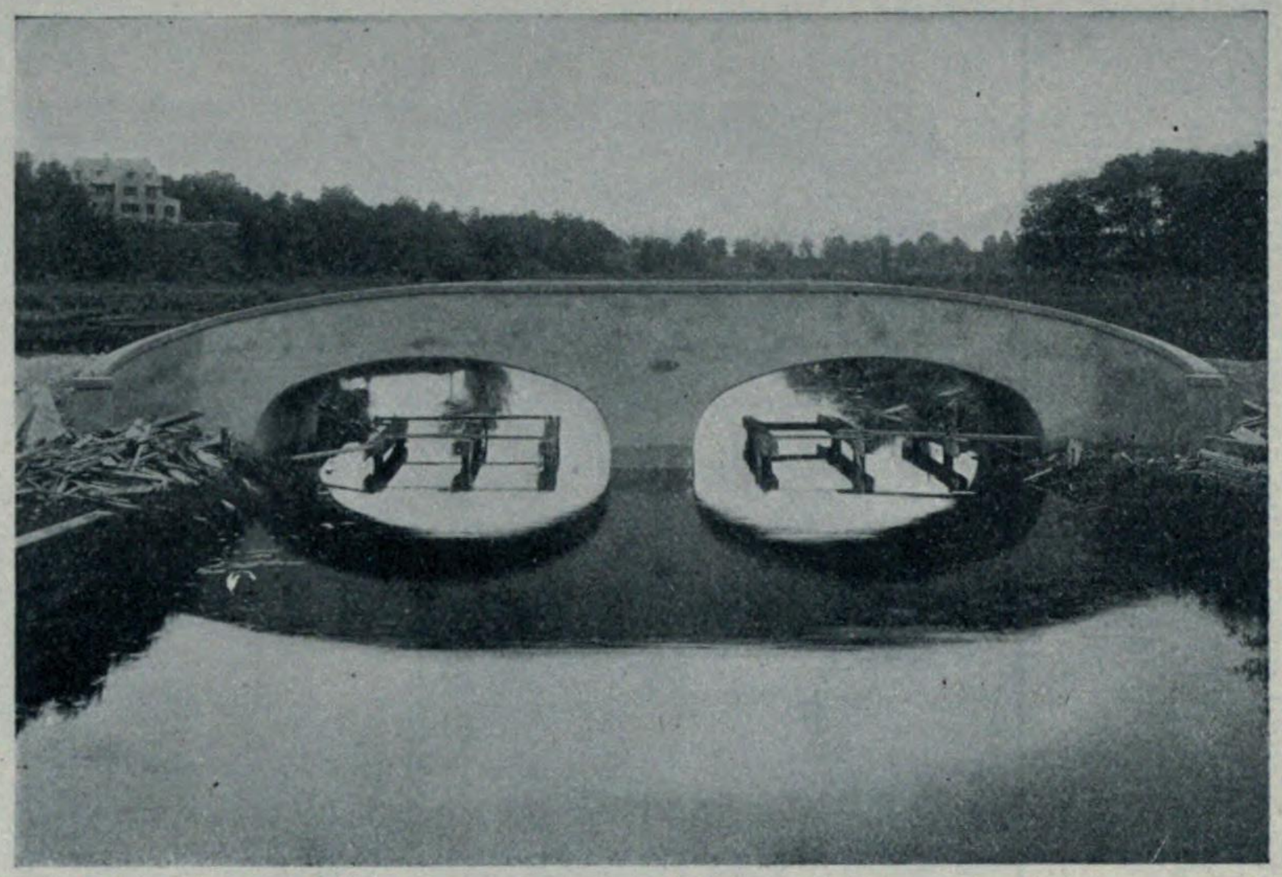
Bridges are frequently the most conspicuous objects in the landscape. Unlike buildings in crowded city squares, which are partly concealed by their surroundings, a bridge can often be seen for a great distance. The greatest injustice to public taste or feeling is the building of an ugly bridge, for the most prominent and useful structure should be the most beautiful, and yet the reverse is too often the custom. City halls, post offices, and other public buildings have been adorned, and bridges have been neglected. A city should realize that it is as important to beautify its bridges as its court-house or city hall. Great terminal depots are often erected in the cities and beautiful though smaller ones at suburban stations, while adjoining bridges, which are often more conspicuous than the depots, are left utterly unadorned.

Bridges should be made ornamental because their form and location are so frequently inviting for artistic treatment. The curved lines of the arch and suspension are in themselves attractive and may be further beautified without much effort. It is easy, therefore, to make a bridge one of the most beautiful and interesting features in a landscape.. No structures show more clearly their object and use, and the opportunity is therefore offered for truthful construction, a prime requisite for good design. Bridges, and especially high ones, are naturally impressive, and no objects in a landscape are longer remembered. Returning travellers often retain the memory of a bridge long after monumental buildings have been forgotten.

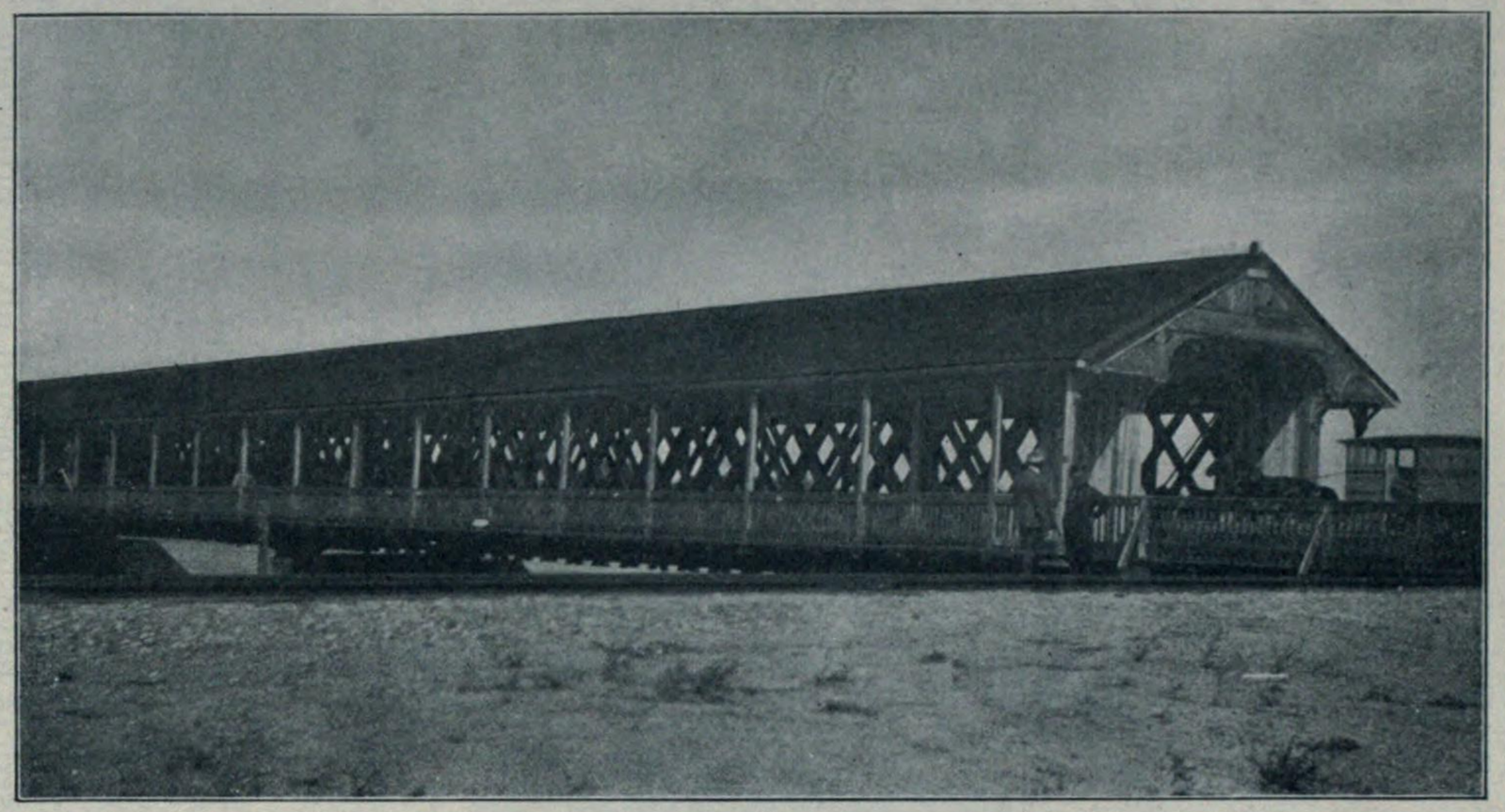


A concrete arch with too flat a rise. The metal balustrade gives it a very light appearance.

Bridges should be made beautiful, because people delight to congregate and loiter there, particularly in the summer time. For this reason a bridge is especially suitable for a memorial structure, as it can be appreciated and admired during leisure hours. Bridges should

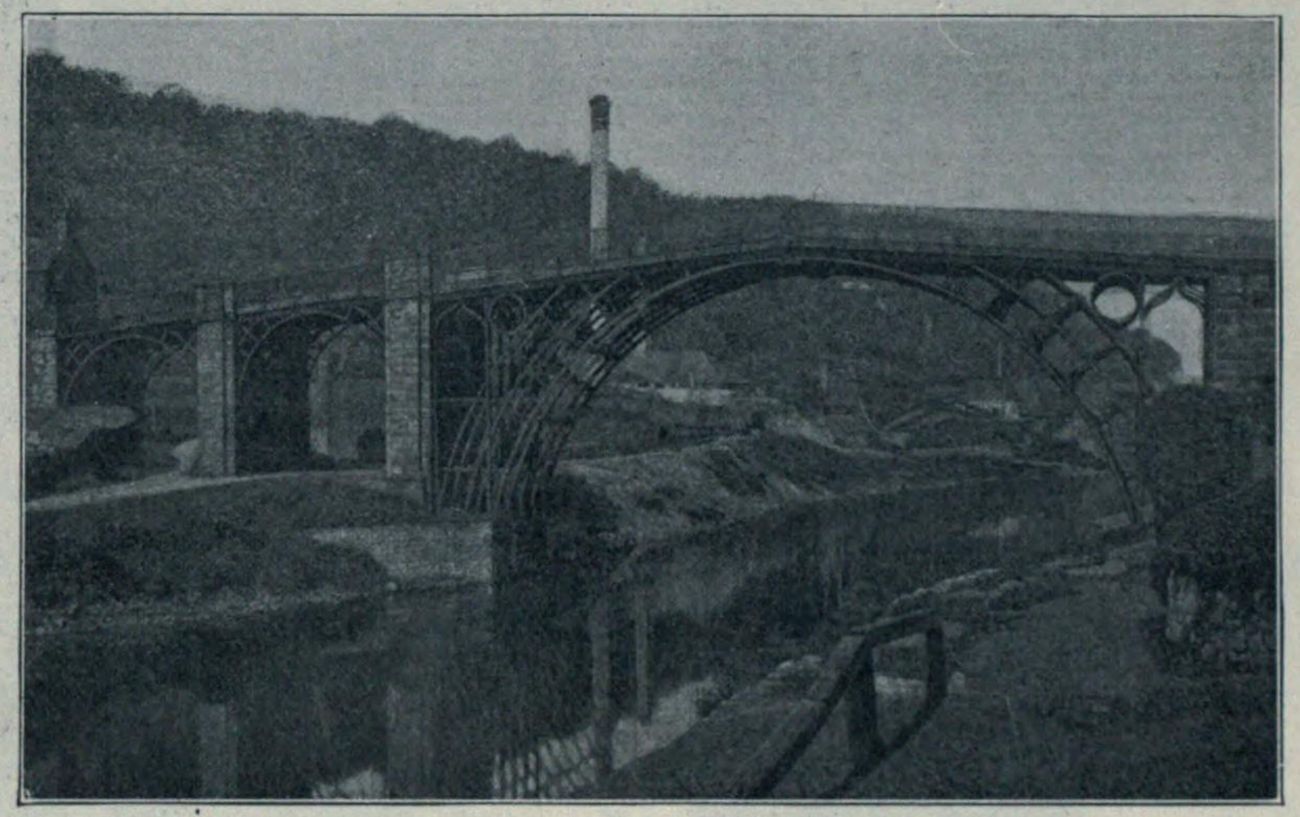


A bridge with cambered and curved wing walls.

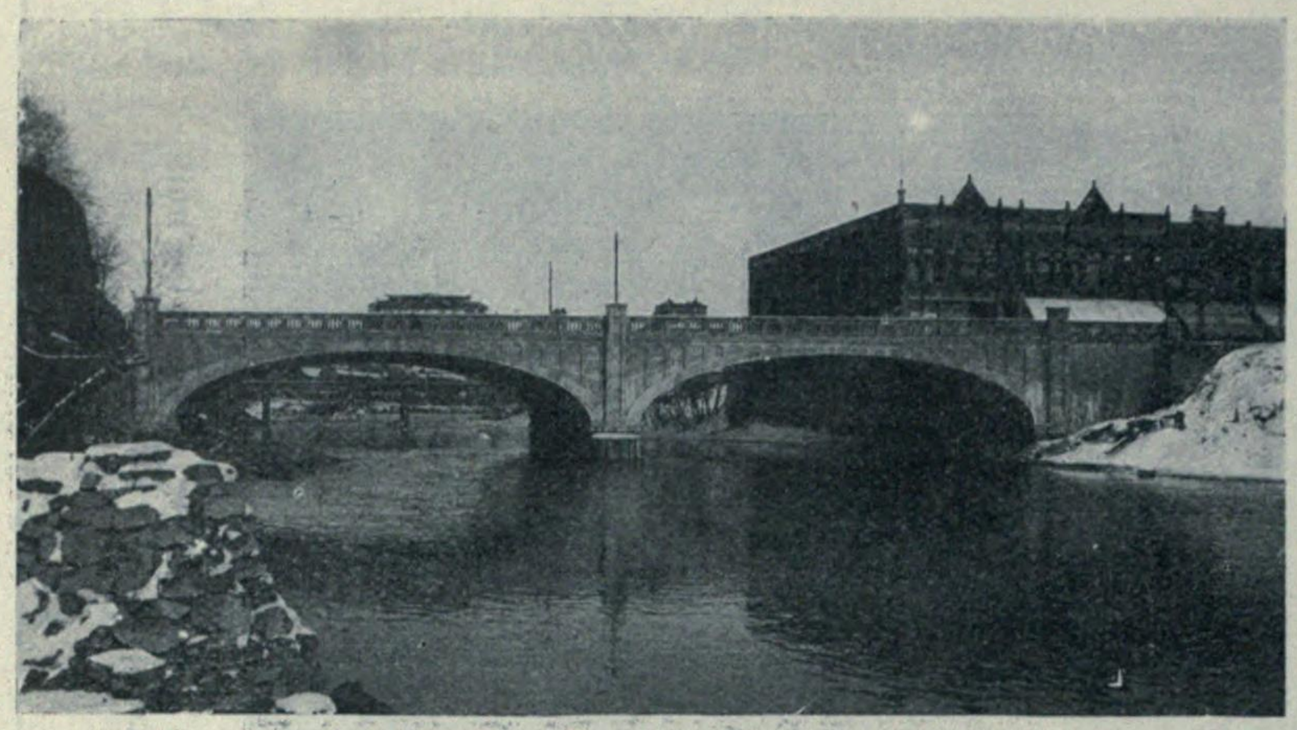


Old covered bridge at Grand Rapids, Mich. A type which generally outlived those of steel.

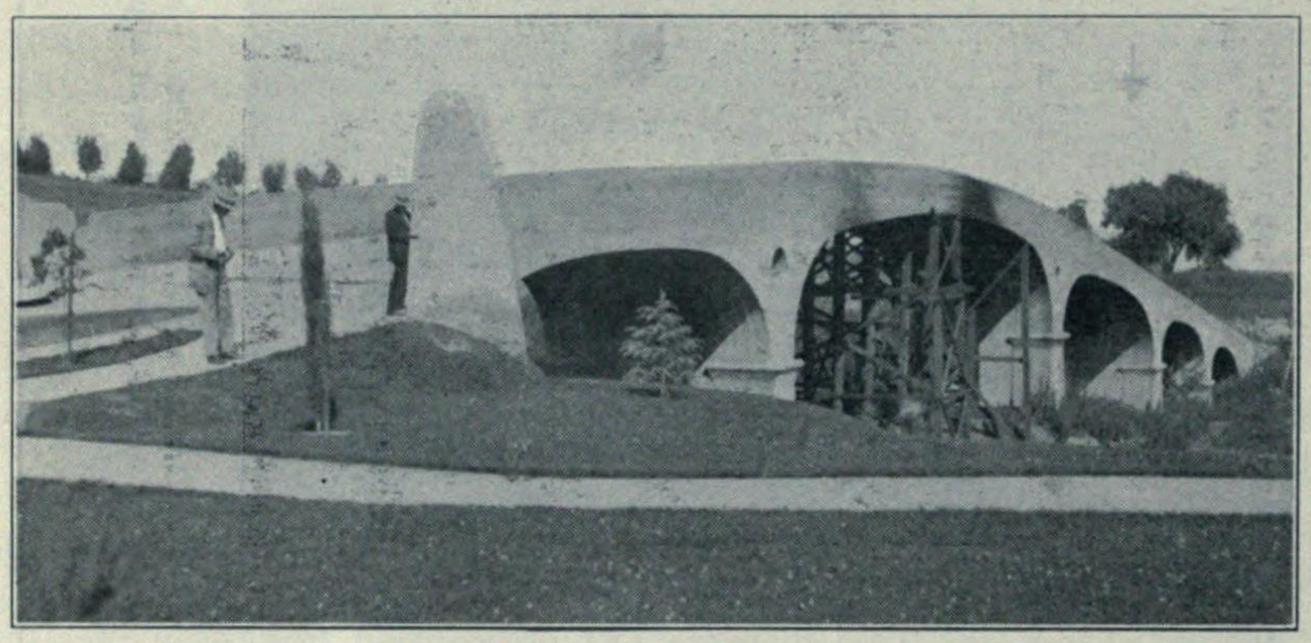
Pontoon bridge at Weed street, Chicago. Disfigurements of this kind may still be seen in many of our cities.



Bridge at Coalbrookdale, England. The first iron bridge ever built. More attractive in appearance than many modern ones.



Bridge at Reno, Nevada. Three spans would have looked better.



A bridge at Pasadena, Cal., with ornamental features at the ends. Photo made during repairs.

be beautiful because the presence of ornamental structures enhances the value of the surrounding property. City officials who have the expenditure of public money should realize the economy of building artistically in and around large centres of population, for money thus spent is frequently a good investment. Fine bridges give a distinctive feature to a city. Those in France and Germany, and some few in America, show possibilities in artistic steel construction. The thirty-two bridges over the Seine at Paris are in most cases models of elegance, standing out in sharp and charming contrast to those in some American cities. But the time for better ones is at hand. Utilitarian bridges, which were excusable in the early days of this continent, should no longer be tolerated. The wealth and commerce of America have so greatly increased that the uncouth forms of past generations are no longer permissible as representative works of a great nation.

Some of the reasons for lack of beauty in American bridges may be stated as follows:

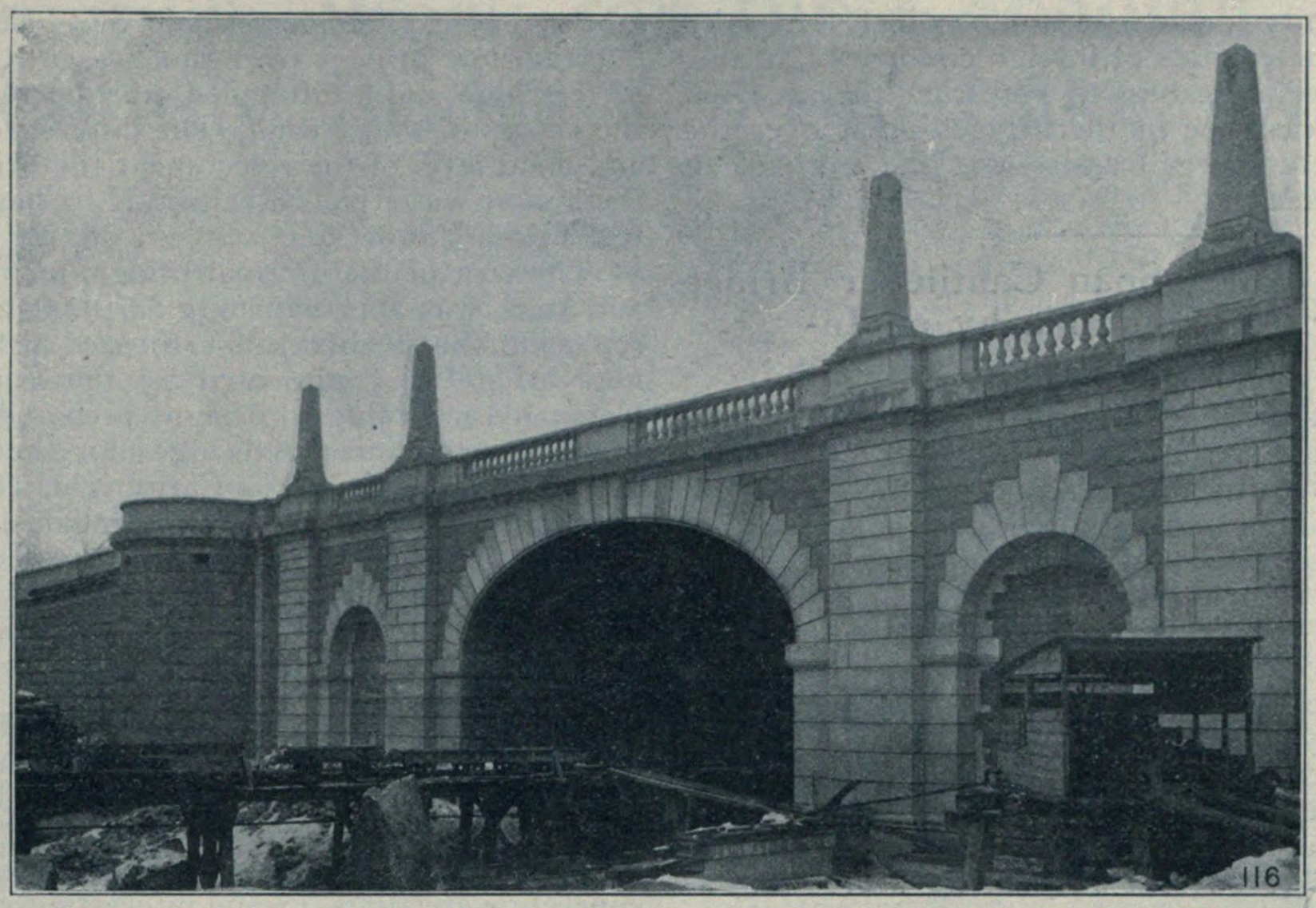
(1) Little or no literature on artistic design has been available and no instruction on the subject has been given in engineering schools. Ugly designs, therefore, are often made, when beautiful ones would cost no more. After selecting a form which is far from the proper one, many engineers are accustomed to compute the stresses in the various parts, even to decimals, when the assumptions may never be realized within one hundred per cent.

(2) Commercialism and competition are responsible to a great extent for a lack of art in American bridges, for as a general rule the cheapest bridge, and consequently the plainest one, is usually accepted, and ornamental designs at greater cost are discarded. Ugly designs are usually prepared by contractors' engineers, whose only motive, frequently, is their personal gain.

(3) Hasty construction is perhaps responsible for more ugly bridges than any other cause. New districts have been opened up by projecting long lines of railroad across the continent, the rapid completion of which has often been dependent on the bridges over which work trains and supplies could pass, and hasty construction has often been imperative.

(4) The American railroad bridge with simple

Foot bridge, Garfield Park, Chicago.



An attractive design for a park bridge. Photo taken before completion.

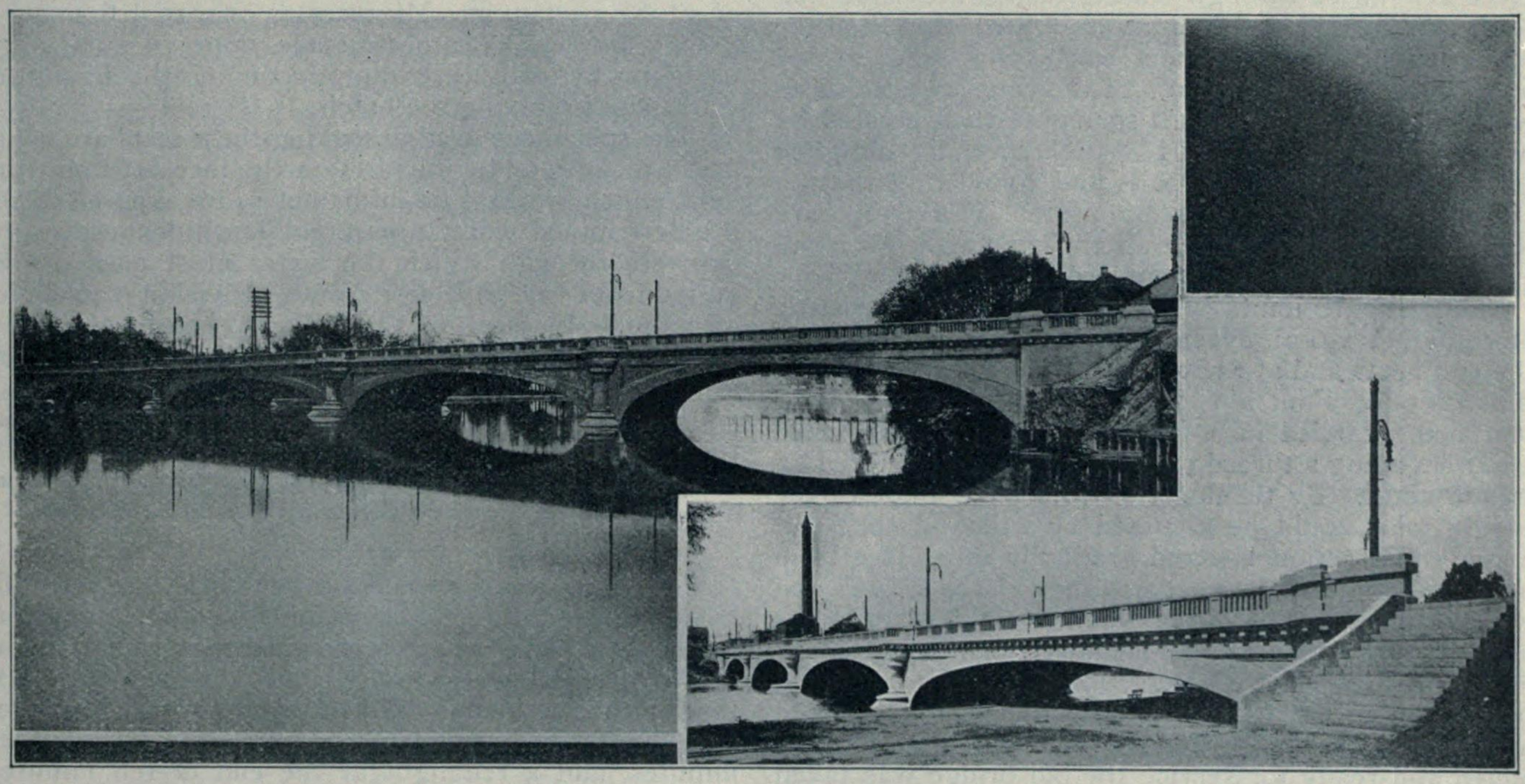
trusses which could be built quickly became the prototype for town and city bridges, and these ugly structures may now be found not only in the country districts but also in and around important cities.

(5) A common excuse for unsightly city bridges is that of insufficient funds or appropriation. This plea is usually without foundation, because cities which spend millions on their public buildings could better afford to beautify their bridges, which are often much more conspicuous.

Bridges have had many uses in addition to forming a passage-way for travel, and ancient ones were frequently lined with shops, or used as a gathering place for citizens. Old London bridge, and others at Florence and Venice were roofed over, and provided with stalls or shops for merchandise. Others had memorial arches, chapels, or fortification towers at the ends, an American example of great merit being the memorial bridge at Hartford, Conn., standing in Capitol Park.

Statuary is a common adornment on the bridges of Paris, Berlin and other European capitals, but features of this kind are noticeably absent in America, only very few containing anything more than simple structural requirements.

When the writer was asked some years ago by the authorities of Copenhagen, St. Petersburg and Sydney



Jefferson Avenue bridge, South Bend, Ind. A very attractive design, though restricted with small arch rise.

to prepare designs for bridges in those cities, the invitations were declined with great reluctance because of the opportunity for artistic design which is usually acceptable in the capitals of foreign countries. In this connection it is interesting to note that the accepted design for at least one of the bridges—that over the Neva at St. Petersburg, Russia—was the work of an American engineer.

Replacing a Three-Span Cantilever Bridge in British Columbia by an Independent Span

ELIMINATION of falsework was the constructional feature in replacing an old 315-ft. bridge span over the Fraser River on the line of the Canadian Pacific Railway, 150 miles east of Vancouver, B.C. The end spans were supported during erection on the old structure and afterward served as anchor spans to counterbalance the main span during its cantilever erection. Erection adjustments of the center panel were made by screw toggles.

The railway follows up the north bank of the river until the canyon swings around toward the north to such an extent that a crossing becomes necessary. The bridge site selected by the locating engineer in 183 has proved to be well adapted for a crossing, as it is one of the narrowest places on the river and has the advantages of giving a good alignment and solid rock foundations.

The original cantilever bridge was erected in 1883-84, the piers being placed close to shore, giving a main span of 315 feet. This location of the piers made it possible to use anchor spans 105 ft. in length, running from the piers to stone abutments, and two cantilever arms and a suspended span—all three of which being 105 ft. long. Thus the bridge had a total length of 525 ft. between abutments. The structure has been in constant use from the day of its completion in 1884 until 1910, when the use of heavier engines and rolling stock made a change necessary.

The old site was considered the most suitable for the location of the new bridge, and it was decided to erect here three through trusses, using the same masonry, with some slight additions, which supported the old bridge. The two short end spans were erected first, using the anchor arms of the cantilever as falsework. The 315-ft. through span was then erected by weighting down the short spans (specially designed for this stress) with old rails and connecting the top chords of adjacent spans by means of a temporary toggle joint which linked up the steelwork so as to employ the cantilever principle during erection.

Four toggle joints were required, each consisting of eight 1½ x 6-in. eyebars connected to steel pins in the end posts and at the center, as shown in one of the illustrations. Four pins were used at the center, each pair being carried in a frame in which was fastened a nut engaging a thread on a vertical shaft operated by a bull-wheel. By turning this wheel the angle of the toggle joint could be changed at will and the span under construction lowered gradually into place from both ends until the two parts met in the center and were coupled up. The maximum weight of rails put on each short span was about 400 tons.

During the course of erection the traffic averaged from eight to ten trains per day, and was maintained without any delays. After the new bridge was completed and ready for service the old bridge was taken out, piece by piece, and utilized on the Esquimalt & Nanaimo Railway, a Vancouver Island branch of the Canadian Pacific Railway, on which lighter rolling stock is used. The piers which were used for both the old and new bridges over the Fraser River are about 82 feet high and are founded on solid rock exposed on the shores of the stream. The difference between low and flood level of the river under the bridge is 67 feet, the lowest water record being 125 feet and the flood 58 feet below the deck.

The cost of the original bridge, including masonry and steel, was approximately $270,000, and the cost of replacing the steelwork is estimated at $160,000. The new bridge was fabricated by the Canadian Bridge Company according to designs prepared by Mr. C. N. Monsarrat, engineer of bridges for the Canadian Pacific Railway. Mr. C. E. Cartwright was division engineer, succeeded by Mr. H. Rindal, and Mr. H. B. Walkem, resident engineer, was succeeded by Mr. F. P. Wilson.—Engineering Record.

Experiments in Waterproof Concrete

A SERIES of tests to determine the rate and the amount of flow of water through concrete is being made by the College of Engineering of the University of Wisconsin, Madison, Wis., with the object of finding a simpler means of making concrete watertight. Some interesting results have already been secured in the effect of the length of the time of mixing in a machine mixer of the batch type; the effect of the percentage of water upon the imperviousness of the concrete; the effect of having sand in dry condition before mixing; and the effect of having the sand wet.

It has been found that good results are obtained if the concrete remains in the mixer from two min. to three min. when dry materials are employed. For cases in which the sand and gravel or stone are damp a considerably longer time is required. Therefore the use of wet sand should be avoided if possible. The experiments show that 1:1½:3 mixtures consisting of cement, Janesville sand of the torpedo grade, and Janesville gravel, when mixed to a wet consistency, are impervious to water when subjected to a pressure of 40 lbs. per sq. in. Mixtures as lean as 1:6, using a graded gravel, have been made impervious at high pressures by using care in proportioning the amount of water and in mixing the batch.

The specimens used in making these tests are cylindrical in form and so made that the faces of the cylinders, which are 13½ in. in diameter, are exposed to the pre-determined water pressure. The thickness of the concrete through which the water must pass can be varied from 4 in. to 18 in. Ample provision is made for cleaning both faces of the cylinder before placing it upon the testing apparatus. The apparatus itself is so arranged that very accurate tests can be made.

The importance of these experiments will be more sufficiently appreciated when it is understood that a large proportion of the trouble arising from poor concrete is due to the use of defective sand or gravel.

The nuisance of speakers at technical and scientific meetings exceeding the time limit was obviated in an ingenious manner at a recent conference on safety and sanitation in New York. By means of an electric fixture on the president's desk a green light was displayed two minutes before the end of the allotted period of ten minutes, and a red light at the end of ten minutes. The speakers did not exceed their time.