SOME NOTABLE GERMAN ARCH BRIDGES.

During the past few years German engineers have shown great activity in the matter of bridge construction, and some of the longest and, architecturally considered, most beautiful bridges in the world have recently been erected in various parts of the German empire. The particular form adopted has been that of the arch, a type which lends itself admirably to successful architectural treatment, and it is needless to say that a people so instinct with true æsthetic perception as the Germans were certain to produce results that would be very gratifying to the eye of the critic. At the same time these great bridges are characterized by ample strength and rigidity—features which are closely associated with the short panel lengths and riveted connections which are a characteristic of most German bridge work.

We have prepared a list of the fourteen longest steel arch bridges in the world, from which it will be seen that, while the longest arch is located in this country, the Germans have recently constructed the second and third longest, while three other of their bridges are to be counted among the first eleven big arches of the world.

Name and Location of Bridge.	Span in Feet.
Niagara, U. S. A	867·8
Rhine bridge, Bonn, Germany	613·3
Rhine bridge, Dusseldorf, Germany	594·5
Luis I., Oporto, Portugal	564·0
Mungsten, Germany	557·6
Grand Trunk, Niagara, U. S. A	550·2
Garabit, France	541·2
Levensau, Germany	535·9
Pia Maria, Portugal	524·8
St. Louis, U. S. A	520·2
Grunenthal, Germany	511·7
Washington, New York	510·0
Paderno, Italy	492·0
Rochester Driving Park	423·0

The longest span is that recently opened across the Niagara River to replace the wrecked suspension bridge. It has a length of 868 feet and is over thirty per cent longer than any other arch in existence.

The next largest arch is the Rhine bridge at Bonn, Germany, which consists of two shore spans of 133 feet and a great central arch of 613·3 feet span. The roadway is carried above the shore spans, and is suspended from the panel-points of the main arch. The shore abutments and the river piers are treated with careful attention to architectural effect, and the whole design is remarkably well balanced and appropriate. Illustrations and a more detailed description of the bridge will be found in the Scientific American Supplement of March 11, 1899.

The two-arch bridge over the Rhine at Düsseldorf, illustrated in the Supplement of February 11, 1899, is a larger structure than that at Bonn, although neither of the spans is as long as the single large span of the former bridge. They are 594·5 feet in length and of practically the same construction as at Bonn, consisting of two arched trusses with a roadway suspended from the panel points. The upper and lower chords of each truss are not parallel with each other, the trusses being considerably shallower at the crown than at the ends, and the deepening at the piers harmonizes well with the massive character of the piers themselves. These bridges were designed and built by Prof. Reinhold Krohn, who is well known in the foremost engineering circles of this and the old country. Arches of this type have been very favorably received in Germany, as witness the bridges across the Rhine, at Worms, and across the Elbe, at Harburg. The rapidity with which open hearth steel has taken the place of wrought iron in German bridge construction is largely due to the influence and labors of Prof. Krohn.

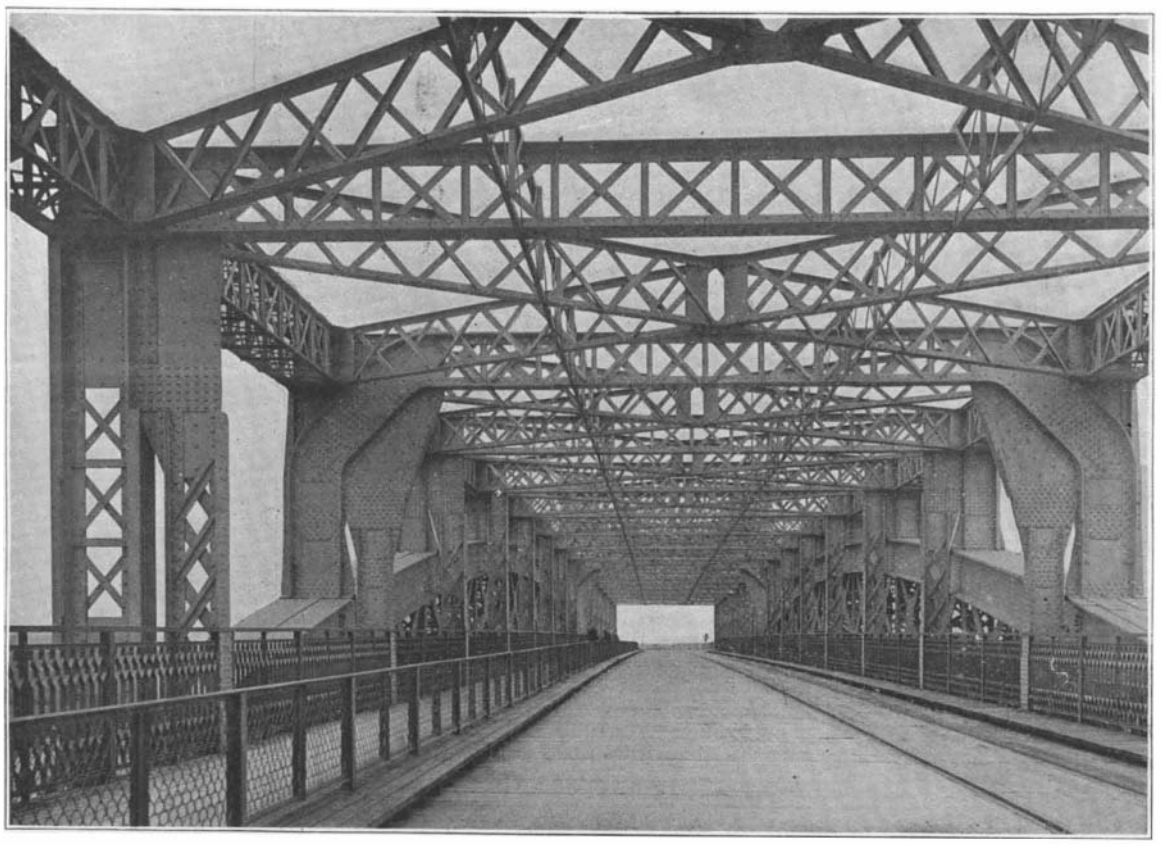
Our illustrations, for which we are indebted to Fritz Müller von der Werra, C.E., of this city, show two other notable arch bridges of recent construction; both of which span the Kiel Canal, one at Levensau and the other at Grunenthal. The Levensau bridge, which consists of a single graceful arch of 536 feet, was designed by the same Prof. Krohn who was responsible for the Bonn and Düsseldorf bridges. The canal at this point, it will be seen, is curved, and to compensate for the curvature (which has a radius of 3,280 feet) and allow ample room for shipping to navigate the turn, the canal is increased in width by 46 feet. The floor of the bridge is designed to accommodate both wagon, street car, and foot passenger travel. The clear width of the wagon road is 27 feet and the clear width of each footpath is 6·5 feet, while the width from handrail to handrail is 33·5 feet. It will be seen that the arches intersect the roadway, dividing the latter into three approximately equal portions.

The most noticeable and original feature of the design is the method of providing for the wind strains and of supporting the roadway. Instead of placing the wind bracing in the floor of the bridge, and supporting the floor directly, by means of vertical supports upon the upper chords of the arches, Prof. Krohn has provided a strong, lateral, overhead truss, which extends from abutment to abutment. Vertical posts extend from this truss to the arch beneath at each panel point, and instead of the floor beams being riveted at their ends to these posts, as would be done in American practice, they are hung, by means of heavy gussets from the panel points of the lateral wind truss, by means of web plates, which are riveted to both the struts of the wind truss and the tops of the vertical posts above mentioned.

To American eyes, this looks like a rather costly and indirect method of construction, and we must confess that the ordinary method of supporting the roadway, as carried out in the Grunenthal bridge, appears to be more satisfactory. We presume, however, that Prof. Krohn wished to avoid the bending strains which would be induced in the vertical posts if the floor beams had been riveted to them in the usual manner. In that portion of the arches below the floor the swaybracing is worked in between the arch trusses and the vertical posts, but in that portion of the arches above the floor the windbracing takes the form of massive plate knee-braces, which may be clearly seen in the view looking through the bridge on the roadway.

The Grunenthal bridge is a particularly graceful arch of crescent form, with a span of 511·7 feet. Unlike the arch trusses of the Levensau bridge, which are vertical, those of the Grunenthal arch have a batter toward each other. The floor provides for a wagon road and two foot paths, the roadway, 21·3 feet in width, being in the center between the arch trusses and the foot paths on the outside of them. The total width of the bridge is 43·4 feet and the height of the roadway above the canal is 137·7 feet. At the center the trusses have a depth of 13·44 feet, and they taper toward the skew backs, where they round in to a depth of 3·8 feet. The upper chord of each truss has a radius of 492 feet, the lower chord a radius of 442·8 feet.

As in the Levensau bridge, the roadway intersects the arches. The lateral bracing is carried in the lower chord of the arch as far as the point of intersection with the roadway, when it is continued in the roadway. Swaybracing is placed between the trusses where they rise sufficiently above the roadway to permit it. Windbracing is also worked in the roadway between the point of its intersection with the arch and the piers.



ROADWAY AND OVERHEAD WIND TRUSS OF THE LEVENSAU BRIDGE.

A Russian Railway Agency in the United States.

According to press dispatches from St. Petersburg, it is stated that in view of the extent to which American manufacturers are now supplying railway material to Russia, that government will establish an agency in New York for the purpose of issuing and registering contracts. It is possible that sub-agencies may be established at either Chicago or Philadelphia.

Magazines for the Navy.

More than $1,000,000 will be shortly expended for the construction of the magazines and factories where the high explosives and ammunition used in the navy are to be manufactured and stored. A Board of Officers was appointed to view the sites submitted. Now that funds are available, no time will be lost in securing the necessary land and beginning the erection of buildings. One of the new magazines will be built on the Palisades, near Edgewater, almost opposite Grant's tomb, on the Hudson River. It will have a frontage of several hundred feet on the Hudson River, and will extend to the cliffs. The buildings will be erected in a secluded place, away from factories and other structures. Now the Navy Department has one small magazine near New York. This is at Fort Lafayette, at the Narrows It is not only a very exposed position, but it is also too small for the purpose and is under the jurisdiction of the Army authorities, which is another reason why the Navy Department should have their own magazines. New York is the chief distributing point, and most of the ammunition during the late war was sent to the ships from there. Ammunition is extremely expensive to transport and handle, owing to its weight and its explosive nature; so that all possible economy should be effected in handling it.

The new magazine and factory in New York will be a great improvement over those now owned by the United States. Buildings will be erected for the storing of ammunition, as well as a laboratory for testing materials for guns and torpedoes. There will also be a building used for experimental work and a large plant for the manufacture of all kinds of powder. The buildings will be of solid construction, iron, steel, and stone being used. Several piers will also be built and the river is to be dredged at this point, so that large battleships can tie up at the piers and ammunition can be taken directly from the storehouses and placed in the magazines of the vessels. This will entirely do away with the expense and delay of handling charged shells. It will also avert the dangers surrounding reshipment. According to The New York Times, the plans will call for tracks to be laid from the storehouses to the wharves. Tracks will also connect with the several railroads whose terminals are in the vicinity of the plant. The buildings are to be equipped with the latest and most improved appliances. It is the intention of the engineers to make this plant the most complete of its kind in the world. When finished and ready for work, it is expected to be able to manufacture sufficient explosives for the entire navy and to have a capacity for assembling nearly all the fixed ammunition and charged shells needed. An Ordnance Officer says: "The war told us our needs and proved that the government should own its own plants, and New York is the place where the largest and best magazines should be built." When asked whether there would be any danger to the surrounding country, the officer said: "We have handled many thousand tons of explosives during the past thirty years, and have not in that time had any accidents." The plant will be away from towns and in the most secluded place. There will be no factories or other dangerous buildings near, and the buildings to be constructed will be as nearly fireproof as possible. The plant on the Hudson River will cost about $600,000. It is expected that work will be begun within the next few months.

Another plant, which will be somewhat smaller, is to be erected at the Naval Proving Ground, Indian Head, a few miles below Washington. The main feature of this plant will be the factory for the manufacture of explosives, the greater part of which will be smokeless powder. Like the plant to be erected at New York, all modern machinery and appliances will be used, and as far as possible, power and heat will be obtained by means of electricity. This plant will cost about $400,000, and it is expected it will be completed January 1, 1900. More than $100,000 has been expended for new machinery and instruments that were used in handling ammunition in the magazines at Fort Lafayette, and, so far as can be learned at present, it is the purpose of the Navy Department to continue to operate the plant in conjunction with the others.

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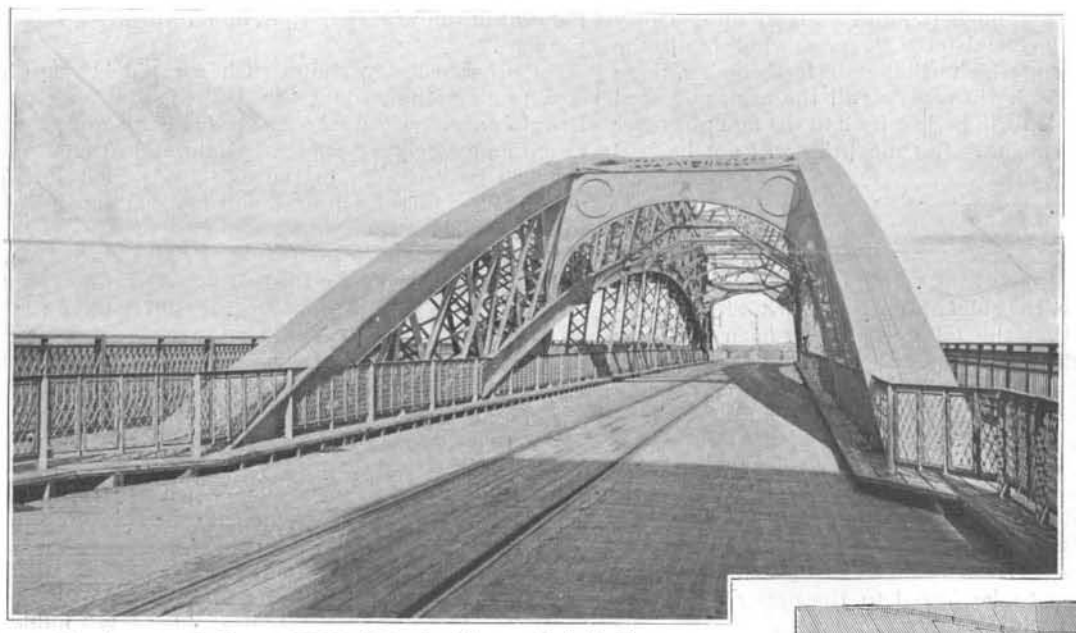
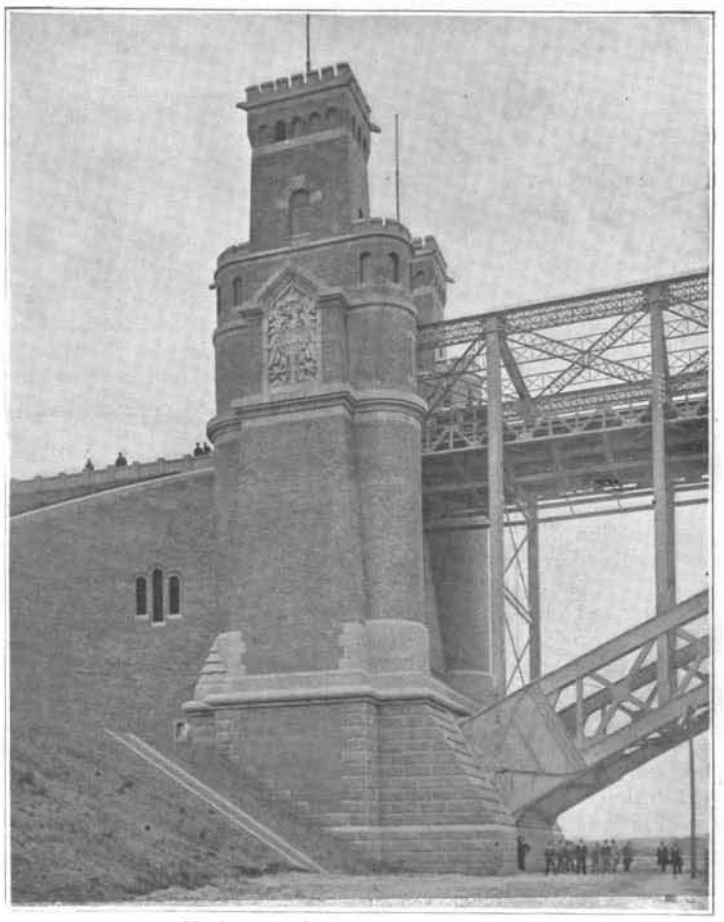
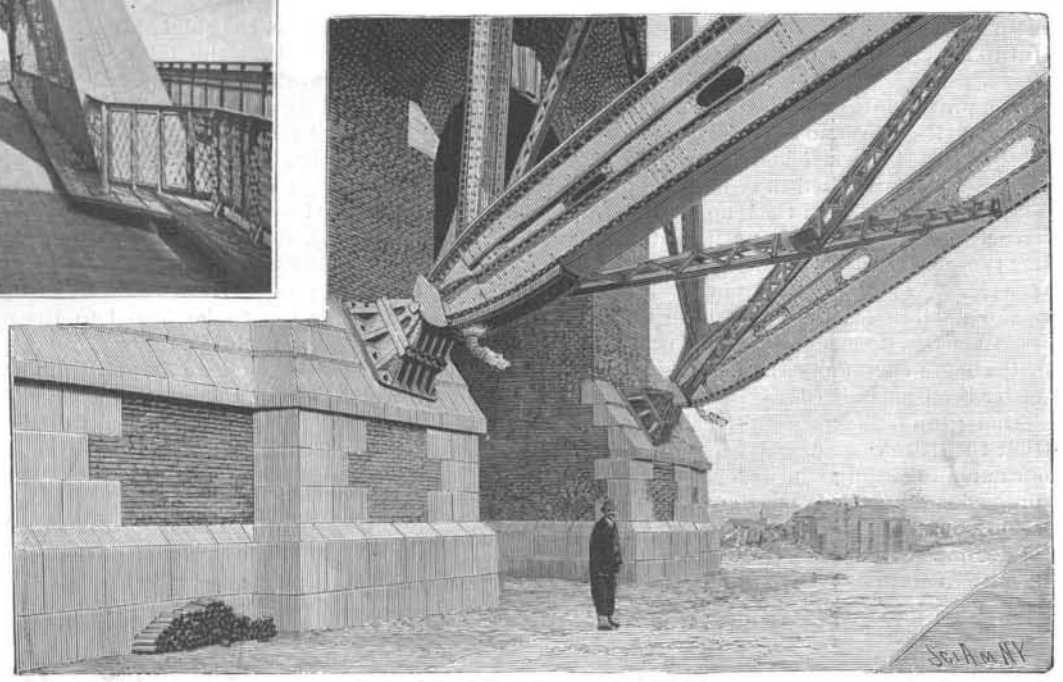
Grunenthal Bridge Across the Kiel Canal. Span, 511·7 Feet.



Roadway and Upper Half of Arch—Grunenthal Bridge.



Abutment of the Levensau Bridge.



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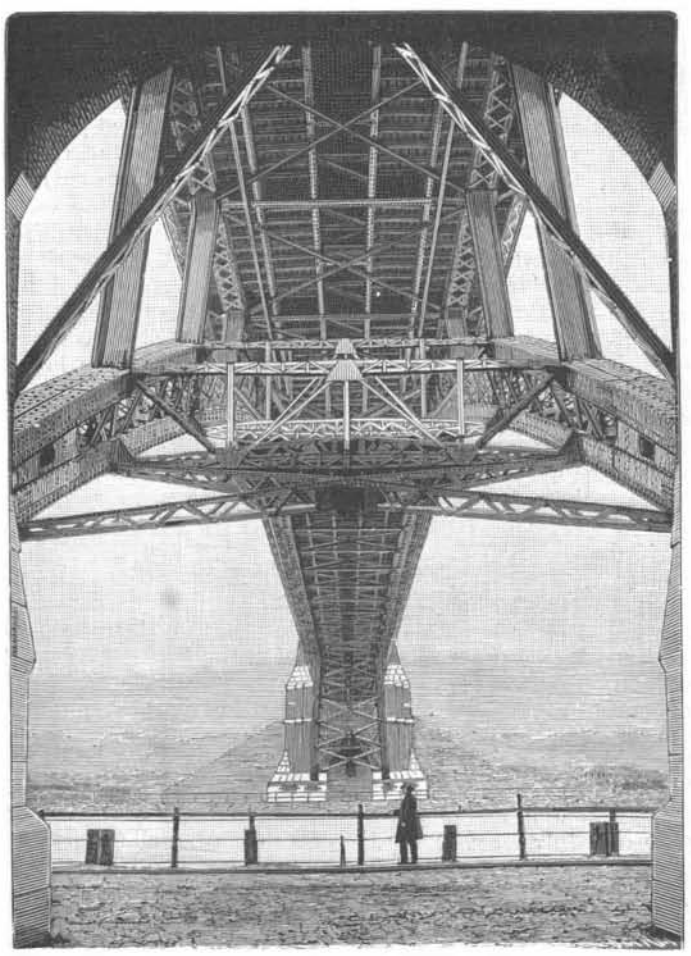
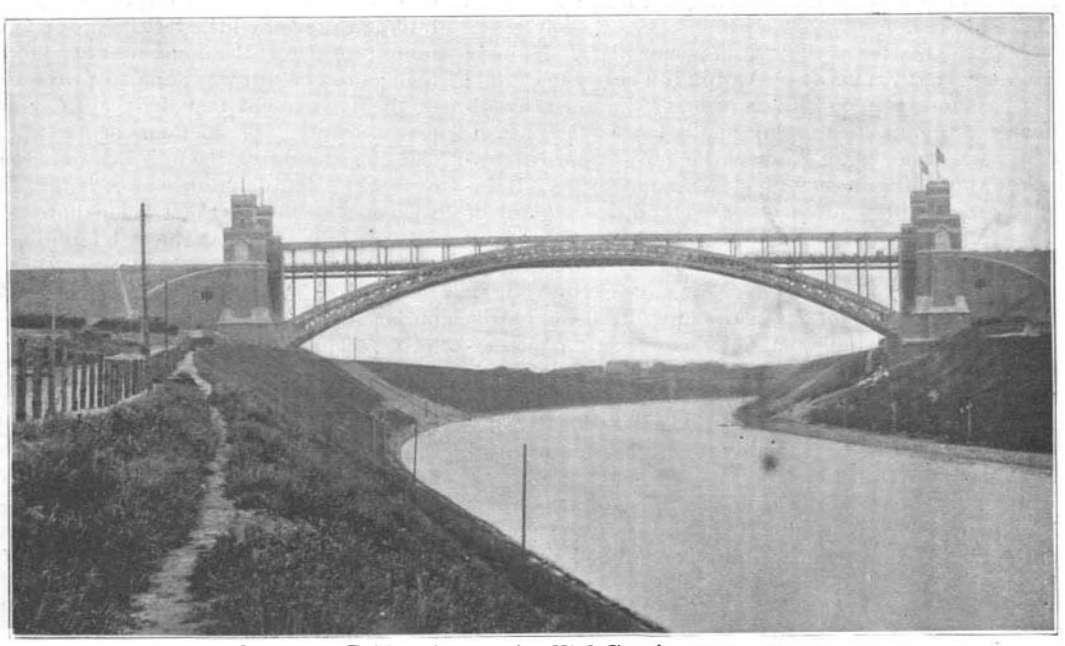


View Looking Along Axis of Grunenthal Bridge, from Below



Levensau Bridge Across the Kiel Canal. Span, 536 Feet.

SOME NOTABLE GERMAN ARCH BRIDGES.—[See page 182.]