RECENT IRON BRIDGE CONSTRUCTION.

We illustrate herewith a road bridge recently constructed by Mr. R. M. Ordish, over the river Pruth, at Czernowitz, Austria.

A cross section of the bridge. with a view in perspective of the girders and their resting point upon one of the piers, is also shown in detail.

The bridge is 762 feet long, and carries a roadway and two foot paths, making a total width of 15 feet between the centers of the girders. There are six openings over the river, each 126 feet from center to center of piers: the five piers and two abutments being of masonry, on concrete foundations. The main girders are continuous, double Warren girders, 11 feet 10 inches deep. The flanges are trough shaped, composed of two large trough irons, 10 inches deep, and a flange plate riveted to them. The diagonals are placed at an angle of 45°, and consist of a pair of flat bars which form the ties, and a pair of trough irons braced together which form the struts. Except at the piers, the main girders have no verticals, nor are they anywhere braced across the top flanges.

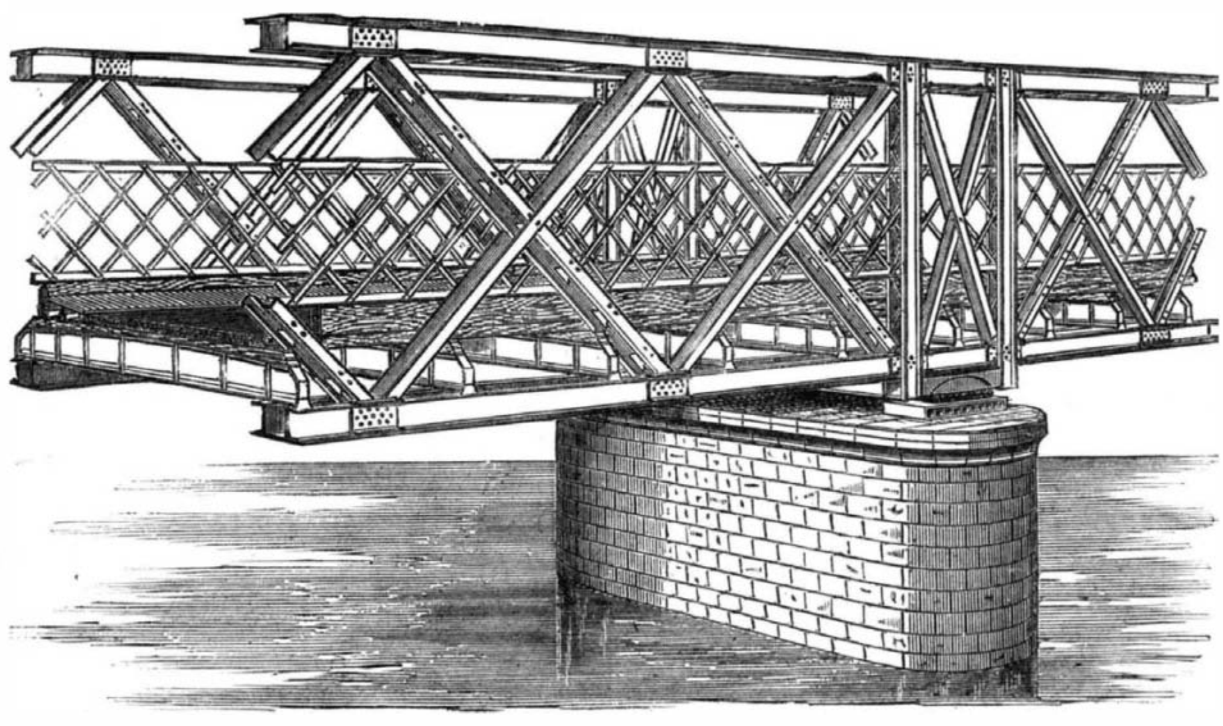
Lateral stability is given to the girders by a special arrangement of the parts to maintain the top flanges in position against side bending. In the first place, the girders are continuous over six spans, and certain parts of the top flange (those over the piers) are always in tension, so that only the intermediate portions have to be held in position laterally. Secondly, at each pier the two main girders rest in strong trough-shaped frames, which resist lateral movement and stiffen a certain length of the girder on each side. Thirdly, the top flange of the girder is made specially broad (2 feet 2 inches, which is 7 inches more than the bottom flange), so that the proportion of length to width in the remaining part of the flange is not excessive. Lastly, all the diagonal struts, which are constructed as girders, and which occur most frequently where, for this secondary purpose, they are most wanted, are connected to the cross girders of the platform by means of a trough-shaped flange, in a manner specially suited to resist any twisting action.

The cross girders are of wrought iron, 1 foot 6 inches deep in the center, and are placed 5 feet 6 inches apart throughout the bridge. The parapet railing is of wrought iron lattice work, bolted at intervals to the main girders, and finished with a wooden handrail.

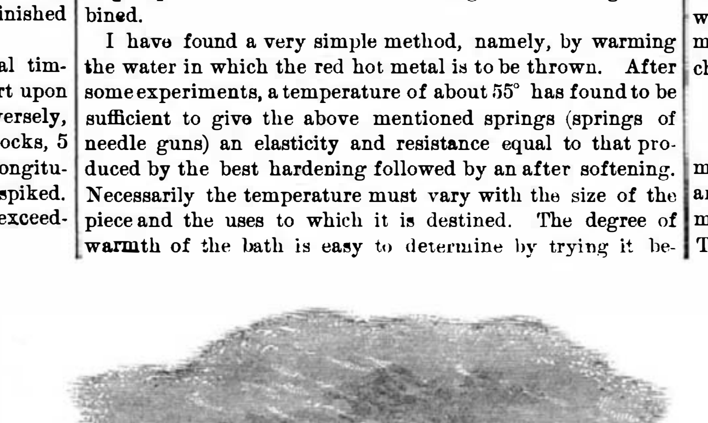
The roadway of the bridge consists of longitudinal timbers, 7 inches by 6 inches, placed about two feet apart upon the cross girders. Upon these timbers is laid, transversely, 4½ inch planking, and upon this, again, rest oak blocks, 5 inches thick. The footway is laid with 3 inch oak longitudinal decking, upon which the wearing planks are spiked. This forms a somewhat heavy roadway, but timber is exceedingly cheap at Czernowitz.

The two main girders rest upon roller bearings at each of the piers, each of these bearings being composed of three castings. The first or upper portion is fixed to the girder between the trough frames, the under side of the casting being concave, and resting upon the second or intermediate casting, to which a corresponding convex shape is given. This arrangement allows for oscillation in the bridge from moving loads, and also insures the central action of the load upon the rollers, and consequently upon the pier. The second casting rests upon eight cast iron rollers, each 4 inches diameter, the rollers moving upon a cast iron bed plate, bolted down to the masonry of the pier. The rollers are omitted from the bearings over the central pier, while the convex form is retained to provide against oscillation. The main girders being thus prevented from moving horizontally at this point, the expansion from increase of temperature radiates outwards from the center, and extends the bridge equally at each end.

The iron work was made in England. The bridge was not thrown open for traffic until it had undergone a careful and searching test at the hands of the government engineer. All the spans were tested individually and collectively. The test load appointed by the Austrian Government, says *Iron*, to which we are indebted for the engravings, for bridges is 30 cwt. per square fathom, or 96 lbs. per square foot, English. This is considerably higher than the proof load used in England, which may be taken at from 70 lbs. to 80 lbs. per square foot of road surface. On account, however, of the increased weight of timber introduced into the platform during construction, the test load was reduced to 25 cwt. per square fathom, or 80 lbs. per square foot. According to the test originally proposed, the load brought upon the iron work of the structure would have been 6 tuns per square inch of sectional area.



SECTION AND GIRDER OF IRON BRIDGE, CZERNOWITZ, AUSTRIA.



IRON BRIDGE AT CZERNOWITZ, AUSTRIA.

Hardening Steel and Regenerating Burnt Iron.

Lieutenant Colonel H. Caron publishes in *Iron* the following account of his investigations, mentioned in brief on page 405 of our volume XXIX:

A piece of steel is first hardened, then softened more or less, according to the hardness or elasticity desired. The hardening, as it is ordinarily practised, that is to say, the hardening of the red hot metal in cold water, frequently has the grave inconvenience of developing rents and cracks disadvantageous to the powers of resistance of the metal. The process of softening then gone through does not cause these defects to disappear; later, in the using, these fissures, invisible at first, increase little by little, and finally end in a serious rupture. It is already well known that, to obviate in part such a danger, it is better to make the steel less hard, and soften it more lightly. A spring heated red hot, hardened in cold water and softened with burning oil, possesses the same elasticity as a similar spring hardened with cold oil (a weaker hardening than the first) and softened with "smoking" oil (a lesser softening than the preceding); only the latter method is more advantageous, because there is less fear of cracks from a too rapid cooling of the metal. Wishing to go farther, I asked myself if it was really necessary to commence by hardening the steel beyond measure just to reverse the process and soften it by a second operation. With this in view, I have sought a hardening of such mildness as to remove as much as possible the chances of cracks, and produce in the steel, at a single operation, the effects of hardening and softening combined.

I have found a very simple method, namely, by warming the water in which the red hot metal is to be thrown. After some experiments, a temperature of about 55° has found to be sufficient to give the above mentioned springs (springs of needle guns) an elasticity and resistance equal to that produced by the best hardening followed by an after softening. Necessarily the temperature must vary with the size of the piece and the uses to which it is destined. The degree of warmth of the bath is easy to determine by trying it beforehand. Hardening with very hot water, and better still, boiling, singularly modifies soft steel containing 0·002 to 0·004 of carbon. It increases its tenacity and elasticity without materially altering its softness; the grain changes in nature; and often where there is a breach, it is found to have become fiberous instead of granular or crystaline, as it was before.

In a communication inserted in the report of the Academy of Science last year, I have demonstrated that the crystaline texture presented by the fracture of pieces of iron is neither due to the action of the cold nor to that of prolonged vibration, but that it existed in the metal previous to its being used. After my experience, that particular formation I found to result from an incomplete forging, leaving the metal still burnt, crystaline, and full of cracks. I saids, besides, that it was possible to give the iron thus deteriorated the fiberous texture or the tenacity which it would have had if the operations of the forge had been gone well through, and that without having recourse, as was formerly done, to a new hammering, which results in a loss of time, of metal, and often in the wasting of the piece itself. The means which I employ to regenerate burnt iron is like that of hardening red hot metal in warm water. I shall cite but one example to prove this.

A bar of Berry iron, 1·2 inches in diameter, easy to break, without a crack, cleft, or flaw, was burnt, that is, warmed in such a manner that, pressed in a screw vice, it could be broken without bending. The fracture was strewn with brilliant facets of many thousand squares. A boiling liquid, strongly impregnated with ordinary salt, was prepared; a piece of the burnt iron, heated red hot, was plunged in this liquid during the time necessary to bring the metal to the temperature of the bath (about 110°). It immediately produced a rather curious phenomenon; directly it was plunged in the salt solution, the red metal was covered with white salt, which detached it from water, and certainly contributed to diminish its cooling. The piece of iron thus hardened was capable of being bent back upon itself, as the bar had been before being burnt. Pure water, boiling, can be employed as well, but its effects are less marked.

Now it is known that boiling salt water can regenerate burnt iron, it will be to the interest of the manufacturer to apply this operation to pieces after being finished at the forge, as the hardening will not damage them at all; if, on the contrary, they have suffered from too much or too prolonged heat, it will give them the qualities which a good forging imparts. Just the same applies to steel.

It is likely that there may be other liquids and other solutions which will produce the same results as the saline solution, but I have only mentioned this one because it appears to me to be the most economical and the most easily procured at the same time.

Steam Engine Accident.

At the spoke works of Messrs. Hoopes & Darlington, West Chester, Pa., the governor belt of a forty horse engine recently slipped off, and the engine ran away at a terrific speed. The engineer promptly shut off the steam, but already considerable damage had been done. The cutter head of a facing machine, being unable to resist the velocity, burst, throwing a piece of metal, weighing 13 lbs., through the wall of the building and across the street; three other fragments were scattered in divers directions, and another machine was similarly disabled.

New Imitation of Silver.

A patent has been obtained by M. Pirsch-Baudvin for a metallic alloy which is declared to resemble silver better than any other yet known with respect to color, specific gravity, malleability, ductibility, sound, and other characteristics. The new alloy is a compound of copper, nickel, tin, zinc, cobalt, and iron. The following proportions are said to produce a very white metal, perfectly imitating silver:—Copper 71·00 parts; nickel, 16·50 parts; cobalt, 1·75 parts; tin, 2·50 parts; iron, 1·25 parts; zinc, 7·00 parts. A small quantity of aluminum, about 1½ per cent, may be added. The manufacture is rather peculiar. The first step is to alloy the nickel with its own weight of the copper and the zinc in the proportion of six parts to ten of copper. The nickel alloy, the iron, the rest of the copper, the cobalt, in the form of black oxide, and charcoal are then placed all together in a plumbago crucible. This is then covered over with charcoal and exposed to great heat. When the whole is melted, the heat is allowed to subside, and the alloy of zinc and copper is added when the temperature is just sufficient to melt it. This done, the crucible is taken off the fire and its contents stirred with a hazel stick; the tin is then added, first being wrapped in paper and then dropped into the crucible. The alloy is again stirred and finally poured into the molds; it is now ready to be rolled and wrought just like silver. A great portion of the zinc is volatilized in the act of fusion, so that a very little remains in the alloy. The superiority of this metal is said to depend principally on the cobalt, to which is due its peculiar argentine luster.

W. R. says, in reference to an article which we recently published, entitled Electricity *vs.* Yellow Fever: "The observer is right, as far as electricity goes. During storms accompanied by lightning and thunder, ozone is formed, and this electric oxygen is a quick and efficient destroyer of all organic substances in the air. A small stick of phosphorus half immersed in water will form ozone."

ONE fifteenth of the length of the St. Gothard tunnel has already been excavated.