NEW STEEL ARCH BRIDGE OVER THE NIAGARA.

BY ORRIN E. DUNLAP.

On Sunday, March 28, the last panel of the great new steel arch bridge across the Niagara gorge was put in place and the arch proper finished. This new arch is being built to replace the old railway suspension bridge, which for so many years has been used by the Grand Trunk Railway. When completed it will compare most favorably with the bridges of its class in this country and Europe. Work was commenced late last fall, and has proceeded throughout the winter without loss of life or serious accident. Preparatory to the erection of the steel, the abutments of masonry were constructed on either side of the river. These abutments are four in number, two on each side of the gorge. At first it was proposed to locate them on the stratum of Clinton limestone, but this was found impossible on the Canadian side, where a foundation of concrete was built. On the New York State side, however, the abutments rest on the limestone. On both sides of the river they are located about midway between the water's edge and the top of the cliff. The stone for the Canadian abutments was obtained in the Queenston, Ont., quarries, and that for the New York State abutments at Chaumont, Jefferson County, N. Y. The abutments are magnificent samples of masonry.

It will be seen from the illustration that the arch as it spans the gorge is most graceful in proportions. It is the first bridge of its kind to be sprung across the Niagara chasm, and its erection has attracted much attention. The length of the main span of the arch is 550 feet between the centers of the end pins. This span is connected to the cliff on either side by a trussed span 115 feet in length. One end of each shore span is hinged to the arch by a pin at the intersection of the end post and top chord of the arch, while the shore end rests on expansion rollers, which in turn rest on the masonry abutments above referred to.

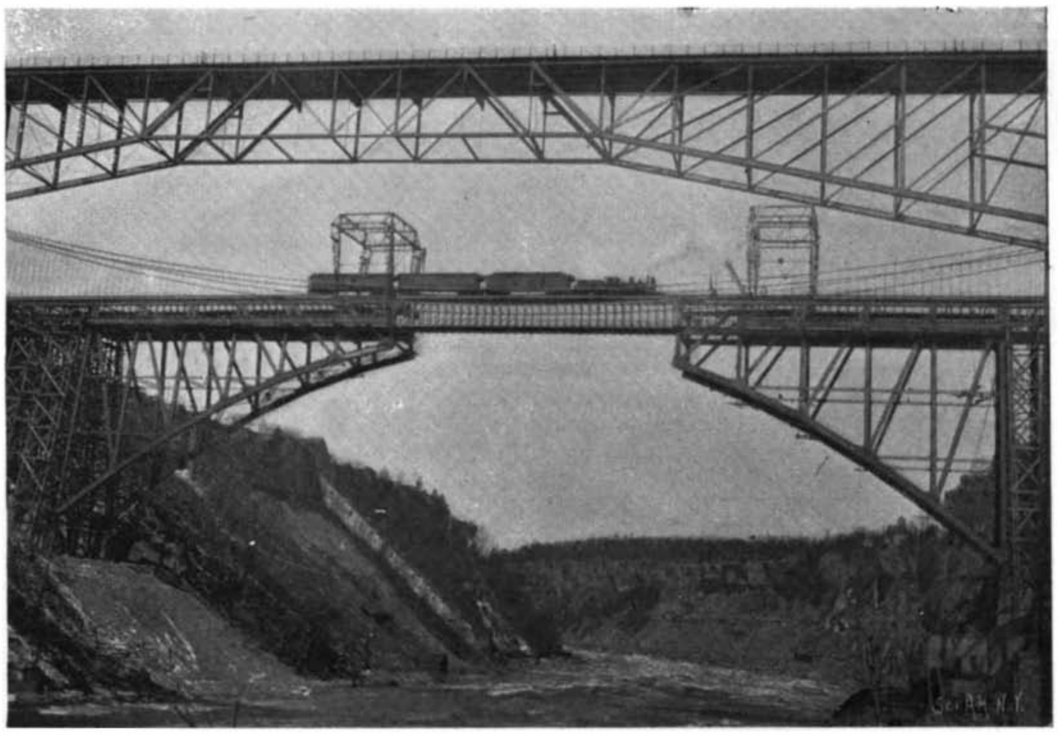
The new arch will have two floors or decks. The upper floor will carry the steam railroad tracks, and the lower one the carriageway, sidewalks and trolley track. The present suspension bridge has but a single track on its upper deck for railway purposes, whereas the arch will be double tracked on its upper deck, thus giving greatly increased facilities to the railroads using it. Resting on the upper chords of the arch, above each post, there will be transverse steel beams, and between these beams will be four lines of longitudinal steel stringers placed 7 feet apart and directly under the railroad tracks. The lower deck will be formed by four lines of longitudinal steel stringers, placed about 11 feet apart, and transverse beams. The I beams which will be placed across the stringers will extend beyond the trusses to carry the sidewalks. It is on this floor that the trolley track is to be laid, and it will be the first trolley track to cross the chasm. It is altogether likely that the first trolley car to pass from the United States into the Dominion of Canada on its own wheels and by its own power will cross this structure. The carriageway and trolley track will be planked with oak plank, and the sidewalks will be a few inches above the carriageway.

All told, there will be in the arch when completed over 6,000,000 pounds of steel. Of this amount it is estimated that there will be about 5,560,000 pounds of steel plates and angles, 218,000 pounds of steel castings, 182,143 pounds of eye bars and pins, and about 30,000 pounds of wrought iron rods, etc. As the great incentive to the construction of the arch was to secure increased facilities for crossing the gorge, it may be imagined that the bridge is designed to carry a very heavy load both on the upper and the lower decks. It is expected that the arch will carry on each railroad track two locomotives with four pairs of drivers each and 40,000 pounds on each driver. This to be followed by a train having a weight of 3,500 pounds per foot. In addition to this it is designed to support a load of 3,000 pounds per running foot on the lower floor, all making an exceedingly heavy load.

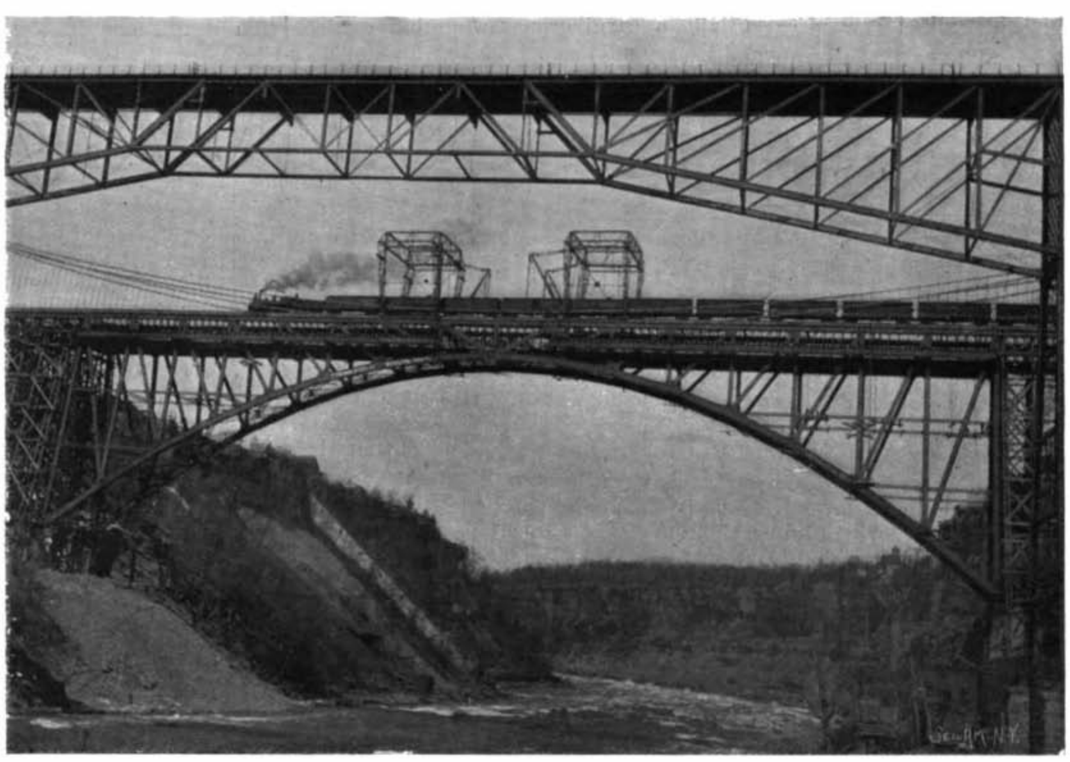
In the construction of the arch the end spans and the first panels were erected on scaffolding built between the abutments and the cliff on each side of the river, a portion of this scaffolding being visible in the illustration given herewith. During all the time the arch has been in building the old suspension bridge has been in constant use, despite the fact that the arch has been built beneath and about it, practically on its very site. This called for the display of rare engineering skill, and extreme accuracy in the length of all the pieces of steel that entered the arch. However, the engineer in charge of the work was Mr. L. L. Buck, who is the chief engineer of the Niagara Falls International Bridge Company and the Niagara Falls Suspension Bridge Company, owners of the bridge, and this is not the first time his rare abilities as an engineer have been called into play by the Niagara gorge and its bridges. The old railway suspension bridge was completed in 1855, having been commenced in 1848. As first erected it was of wood, the towers being of stone. In 1880 the suspended structure was renewed in steel, and in 1886 the stone towers gave way to new ones of steel. All this difficult work of renewal was done under Mr. Buck's supervision, without the least interruption to the regular traffic on the bridge. As the new arch is designed to take the place of the railway suspension bridge, the latter structure will soon be taken down and removed. When this is done one of the oldest and best known landmarks on the Niagara frontier will disappear. It was owing to the location of the suspension bridge in 1848 that the town of Bellevue changed its name to Suspension Bridge, this village having been merged into the city of Niagara Falls in 1892, but the old name, "Suspension Bridge," still sticks to the place, and the railroads continue to carry it on all their printed matter. The railway suspension bridge was the first great bridge of its kind to be erected in the United States, and its passing is of more than local interest. The dimensions of the new arch will be best understood by comparison with other great arches of the world, the dimensions of which are as follows:

	Span.	Rise.
Louis I, Oporto, Portugal	566	146
Garabit, France	543	170
Pia Maria, Portugal	525	121
Washington Bridge, New York	510	91·7
Eads St. Louis Bridge	520	47
Paderno, Italy	492	123
Rochester Park	428	67

The contract for the erection of the arch is held by the Pennsylvania Steel Company, of Steelton, Pa., and they expect to have the bridge completed and the old bridge removed some time in June.



VIEW SHOWING OLD SUSPENSION BRIDGE AND NEW BRIDGE UNCOMPLETED.



NEW STEEL ARCH BRIDGE OVER NIAGARA RIVER.

Deepest Bore Hole in the World.

The deepest bore hole in the world, says Mr. C. Zundel, in a late communication to the Industrial Society of Mulhouse, is one of 6,571 feet below the surface of the soil, made at Parnschowitz, near Rybrick, Upper Silesia. The previous record for depth was the 5,733 foot hole drilled some years ago at Schladebach, near Leipzig. The later bore hole was made in a search for coal measures, and 83 separate seams, some of considerable thickness, were penetrated. The hole was 12 inches in diameter at the beginning and this was lined with a tube about 0·4 inch thick; at a depth of 230 feet the bore was reduced to 8¼ inches diameter, and thus continued for 351 feet. At this point the blue marl encountered became so compact that the diamond drill had to be used, and under the action of the water the marl swelled to such a degree that the diameter of the pipe had to be again reduced. The greatest difficulty encountered was the great weight of the boring rods, as the depth increased. Though steel was used, at a depth of 6,560 feet the total weight of the tools reached 30,155 pounds. Under this weight ruptures of the rods were frequent, and an accident of this nature finally stopped the work; about 4,500 feet of rods fell to the bottom, and, being jammed under a part of the tubing, it was impossible to withdraw it. The diameter of the well at the bottom was 2¾ inches. Temperature observations made showed 12 C., or 53·6° Fah., at the surface, and at the depth of 6,571 feet the temperature reached 69·3° C., or 157° Fah. This is equivalent to an average augmentation of heat of 1° C. for every 34·14 m. of depth, or 1° Fah. for every 63 feet. These figures differ slightly from those obtained in other deep borings. The increase of heat at Schladebach corresponded to 1° C. in 35·45 m.; that at Sperenberg, near Berlin, to 1° C. in 32·51 m.; and at the artesian well of Grenelle, at Paris, which is only 1,797 feet deep and furnishes water at a temperature of 27·70° C., it is estimated that the increase of heat is equivalent to 1° C. in 31·83 m. The boring at Parnschowitz was commenced on March 26, 1892, and it reached its maximum depth on May 17, 1893, or in 399 working days. The total cost was $18,800, or about $2.86 per lineal foot.

THE recent observations of Perrotin at Nice (France), and of Lowell at Flagstaff, Arizona, says Prometheus, have confirmed the theory that Venus and Mercury revolve on their axes like the moon; that is, the periods of rotation and revolution are identical. Herr Brenner's alleged discovery of a short time of rotation for Venus (about twenty-four hours) therefore proves a fallacy. According to Lowell, Venus is not veiled by clouds, but by a dense atmosphere.