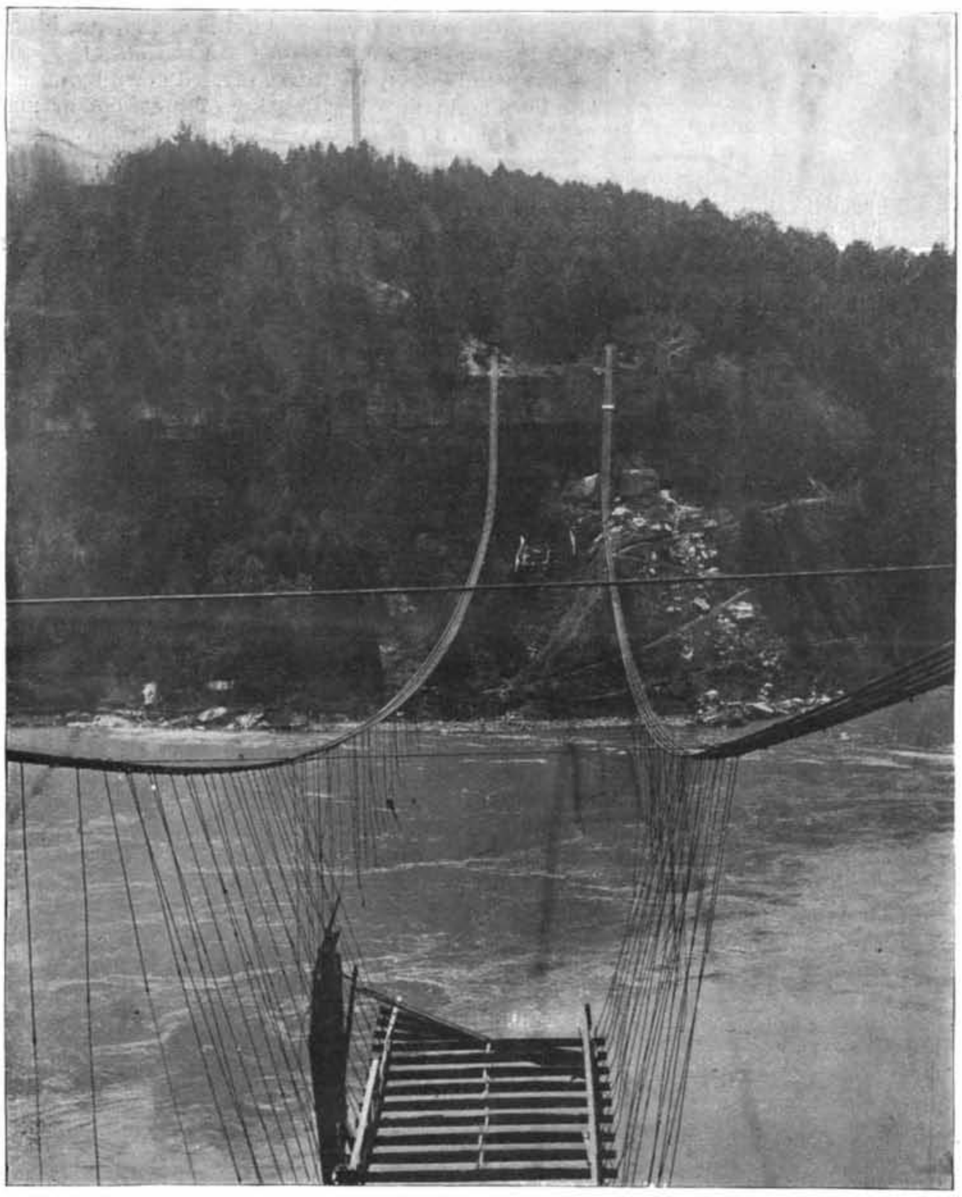
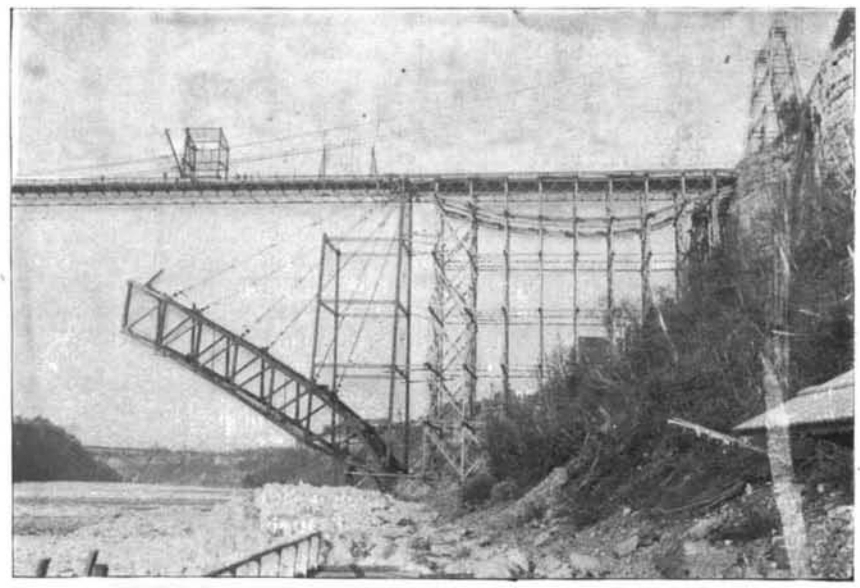
THE NEW STEEL ARCH AT NIAGARA.

The work of erecting the steel of the new all-metal arch which is to take the place of the upper suspension bridge at Niagara Falls has commenced and is being carried on with such vigor as to convince one that, for all the river is very wide at this point, it will not be long before the two great arms of the arch, now building out from each side simultaneously, will meet and be joined over midstream. The bridge that the arch is to replace is the last of the great suspension bridges across the Niagara chasm at the Falls. It was built in 1889 under the supervision of G. M. Harrington, to fill the gap between the cliffs caused by the wrecking of a former bridge by a hurricane on the night of January 9-10, 1889. The first bridge on this site was of wood and iron. To prepare for its building, connection was made between the cliffs by carrying a rope across from bank to bank on an ice bridge. By means of this rope cables were strung, and the first bridge on the site was opened to the public January 2, 1869. The roadway, being but 10 feet wide, was not large enough to allow carriages to pass on it, and so long waits at either end were occasioned in crossing. The towers of the original bridge were also of wood, consisting of 12 by 12-inch pine timbers, 16 of hurricane from the southwest. Within a few hours of the calamity, however, contracts had been let for the material for another bridge, and the work of reconstruction was rushed night and day. Material was on the ground in seventy days, and on March 22, 1889, the work of rebuilding the bridge was commenced. On May 7, 1889, traffic across the gorge was resumed, and the structure was hurried to completion. Once more the bridge companies viewed their work with extreme satisfaction. The new structure was given additional strength, and it was the common belief that it would last for ages.

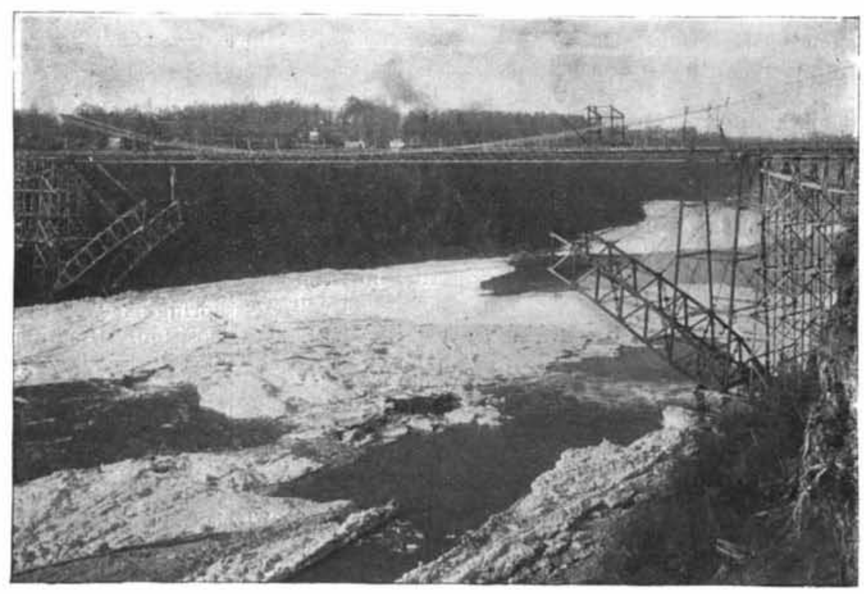
Not so, however. The elements of nature had wrecked one structure, and other factors were to bring about the removal of the later structure. Chief among these was the element of progress. When the suspension bridge was completed, the Niagara locality had not yet felt the developing influence of the electric road system. This experience it was yet to have. The trolley made its entrance. It laid hand on and captured beautiful routes along the Niagara gorge on both sides of the wild and attractive river. Then came the thought that a connection between the electric roads on the New York State side with those on the Canadian side, together with a crossing between Lewiston, N. Y., and Queenston, Ont., would form a belt line destined to win wide popularity. Such a scheme, however, necessitated the construction of a stronger bridge across the gorge; for the new suspension bridge had been designed with the idea of running heavy trolley cars across it. These are the incidents that led up to the building of the new steel arch, which, when completed, will be the greatest structure of the kind in the world.



WRECK OF THE OLD LEWISTON SUSPENSION BRIDGE.



NIAGARA STEEL ARCH—FALSE WORK AND STEEL GUYS.



ERECTING THE STEEL ARCH WITH THE AID OF THE PRESENT SUSPENSION BRIDGE.

THE NEW STEEL ARCH AT NIAGARA.

which were grouped together under the saddle plate to support the main cables. In building the old bridge the arrangement of the members of the towers was so planned as to admit of the widening of the suspended structure from a single track 10 feet in width to a double track 17 feet wide, to permit of the passage of vehicles in opposite directions. This work of enlargement was commenced in the fall of 1887 and consisted of sinking shafts for new and increased anchorages to support the two additional cables required to support the increased weight of the superstructure and the additional floor surface of the widened bridge. After the 2¼-inch steel ropes, seven of which formed each cable, were placed in position and the suspenders for supporting the trusses had been attached, the trusses were sent out from the ends in 30-foot sections until they met in the center and were connected, after which the work of removing the old wooden structure and inserting the new floor system was begun. On the night of June 12, 1888, the last part of the old wooden bridge was removed, and on December 15, 1888, the new steel suspension bridge was pronounced as completed. It was considered a memorable occasion. The bridge companies had every reason to believe the new structure would last longer than they would live to control it. In this they were in error. On the night of January 9-10, 1889, before the bridge was a month old, it was swept away by a fierce

At the point where the bridge crosses, the cliffs are 1,268 feet apart. The abutments are located close to the water's edge and the clear span will be 868 feet long. It will be by far the longest steel arch in the world, as will be evident from the following comparison:

Name of Bridge.	Span.	Rise.
Niagara, U. S. A.	868 ft.	150 ft.
Louis I., Oporto, Portugal	566 "	146 "
Garabit, France	543 "	170 "
Grand Trunk, Niagara	550 "	114 "
Pia Maria, Portugal	525 "	121 "
Eads St. Louis Bridge	520 "	47 "
Washington Bridge, New York	510 "	91·7 "
Paderno, Italy	492 "	123 "
Rochester Driving Park	423 "	67 "

The main span will be connected to the cliffs by two shore spans, one of which will be 210 feet long, the other 190 feet. The arch will be a single deck structure. Its width will be about 49 feet, and this will be divided longitudinally into three parts. In the center, about 23 feet will be given up to double tracks for an electric road service, and on either side of the tracks there will be carriageways about 8 feet wide, while beyond these, elevated a few inches above the roadway, will be walks for pedestrians. The rise of the bridge will be about 150 feet from the level of the piers at the skewbacks to the ribs at the crown of the arch. The depth of the trusses is about 26 feet. The floor of the arch will be about 192 feet from the surface of the water in the river. The arch was designed by L. L. Buck, and he is the chief engineer of the work. The contract for building the bridge is in the hands of the Pencoyd Iron Works, of Philadelphia.

It is evident that to rebuild such a bridge as the suspension bridge across the Niagara with a bridge of different pattern, on the very same site, and without interfering with travel over it, calls for considerable skill and ingenuity. Skilled labor only can be employed, for an inexperienced workman may not only lose his own life, but he may do that which might bring death or injury to others, especially in such a dangerous work as that at Niagara, where to drop from the work means almost certain death.

The decision to build this arch was made some years ago. The abutments were built in the fall of 1895, and have ever since awaited the erection of the steel upon them. The abutments are four in number, two on each side of the river, standing about 67 feet apart. They are located close to the edge of the water in the lower river. The method of their construction was as follows: The accumulated dirt and loose rock on the debris slopes of the river bank at the points of operation were removed until solid rock was reached, hydraulic means being used in this excavation. The rock was cut away in step form and on this a concrete foundation was built. The concrete used was made of Portland cement mortar and broken stone that would pass through a two-inch ring. The stone used was flint rock, the engineer in charge objecting to the use of sandstone or limestone, owing to the pressure the abutments would have to sustain. One measure of cement was mixed dry with 2½ measures of clean, sharp Canadian sand, and then water added to make a moderately thick paste. Broken stone was spread over the mortar in proportions of about 4½ measures to 1 to insure filling all voids with mortar. This was thoroughly mixed and deposited in layers of 10 to 12 inches and rammed sufficiently to flush the interstices with mortar. Into the concrete portion of each abutment four 3-inch wrought iron anchor bolts or rods 21½ feet long were built, each extending 10 feet beyond the concrete surface. In addition to the four rods sunk in the concrete, four other rods of the same material and size pass through the stone work of the abutments, making in all eight anchor bolts in each abutment, the end of each one extending beyond the coping stones about one foot to afford an anchorage for the iron anchor plate or shoe. The total weight of the 32 rods in the abutments is 9,910 pounds, while the 32 washers countersunk in the concrete weigh 3,536 pounds, the latter being of cast iron free from flaws. The abutments are magnificent samples of ashlar masonry, the stones used weighing from two to six tons apiece. Three of the stones used for the copings of the abutments on the New York State side weigh six tons apiece and measure 7 feet 6 inches wide by 2 feet thick. The stone was obtained from the Chaumont, Jefferson County, quarries, and it was found necessary to drill 4-inch holes through over half of them in order to lower them over the anchor bolts. It was found necessary to employ derricks of unusual strength in lowering the stones over the bank. They were dropped 60 feet to a skidway, and then lowered about 190 feet along the skidway to the work.

Preparatory to the erection of steel, the Pencoyd Bridge Works erected great structures of timber false work between the abutments and the banks. This false work extends from the bank up to the floor of the bridge. Temporary anchor pits had already been provided on top of the bank at each end of the bridge. The top chord of the arch was run out on the suspension bridge, and the placing of steel on the abutments commenced. The river span or main arch is being built first, and as fast as two chords of the arch are placed, anchor cables are run down to sustain the weight. Movable derricks, erected on the suspension bridge, aid in letting the iron down to the point needed. Since the shoes were placed the work has progressed with surprising rapidity. It is expected that the arch will be completed during the summer.

The present suspension bridge will be taken down and rebuilt on the site of the old Lewiston suspension bridge, seven miles down the river, below the falls. There it will take the place of the picturesque old wreck, which, since April 16, 1864, has swung back and forth in the breeze, telling the story of man's carelessness to properly guy it before the coming of a storm which swept its floor away. The guys had been loosened during an ice jam, fearing that when the ice went out it would carry the guys with it, and, fair weather following, the men in charge forgot the necessity of re-anchoring the guys. When a storm swept down the gorge, the bridge fell easy prey to its violence. It is understood that the suspension bridge, in its new location, will have a trolley track on its floor to allow trolley cars to cross the river at that point, thus forming a part of the proposed belt line about the gorge.

Incidentally it may be remarked that plate No. 2 shows three bridges—the suspension bridge, the new steel arch in construction, and one of Niagara's famous ice bridges, reaching from shore to shore. The form of the ice bridge changed during the short time the pictures were being taken. This was because it was preparing to go out, or pass down the river, which it did within an hour after the views were taken.

The Typewriter Barred Out.

A rule of the House of Commons is that all petitions must be laid before that body in written or lithographic form, but recently the Hon. Mr. Gedge submitted a memorial from his constituents of the town of Walsall in typewritten manuscript and created quite a sensation, says The Chicago Record. The Speaker declined to receive it, on the ground that it was a violation of the rule and an infringement on the dignity of the House. He contended that typewriting was neither manuscript nor lithography, although he admitted that the rule was adopted before the invention of typewriters. Mr. Gedge gave notice that he would take the earliest opportunity of moving an amendment to the rule, in order that a modern invention which is of great convenience and a decided improvement over pen and ink manuscript might be recognized.

The same rule applies to all of the official departments of the British government. All documents that emanate from the various branches of the Ministry are still written in long hand upon the same kind of paper that has been in use for several centuries and is manufactured expressly for them. No private individual is allowed to use official paper for any purpose whatever. And quill pens are still the ordinary instruments of literary labor in the executive departments as they are in the universities, the courts and in the old-fashioned lawyers' offices. We visited an examination room in one of the colleges at Oxford the other day where a lot of students had just finished the examination known as the "Greatgo," which comes at the end of the college year, and upon the table in the center was a large box filled with several hundred quill pens which had just been discarded by the students and were being gathered up by the janitors. It was only recently that steel pens were allowed in the Bank of England.

A typewritten communication on official subjects would not be received in some of the British offices nor in the courts, but we in America are almost as far behind the times, for it is only since the Harrison administration that typewriters have been used in the State Department at Washington. Even now all communications to the foreign legations of the United States and the diplomatic representatives of other governments at Washington have to be written in long hand. Our ministers abroad are still required to use the same method in preparing their dispatches to the government. Mr. Blaine was the first man to introduce the typewriter, and if he had remained in office several years longer, that convenient instrument would have been furnished to all of the foreign representatives of the United States.

AN AUTOMATICALLY CLOSING UMBRELLA.

The illustration represents an umbrella of comparatively simple construction, which may be conveniently opened, but is designed to close automatically on simply pressing a knob or button. The improvement has been patented by Charles E. O. Hager, of North Baltimore, Ohio. The small figure is a sectional view of a portion of the handle and the ribs folded down. In the outer end of the hollow stick slides a rod carrying near its outer end a crown on which are fulcrumed the ribs supporting the cover, and each of the ribs is connected by a sectional brace with a runner rigidly connected by a pin with the sliding rod, the pin extending through slots in the outer end of the stick and the crown and the runner moving in unison. The brace has a short outer pivoted section, and the middle of its main inner section is pivotally connected by a link with a crown rigid on the outer end of the stick. The inner end of the sliding rod has a reduced portion on which is a coiled spring, and its extreme inner end has a knob which projects through an aperture in the stick near the handle, the knob engaging the aperture when the umbrella is open, and holding the several parts locked in open position. When the umbrella is closed, the

HAGER'S UMBRELLA.

spring is extended to hold the several parts in closed position. By having the short section in each brace, the ribs readily open when the rod is pressed inward, as the short section can readily give until it opens out into a straight line with the other section.

The First Railroad to the Arctic Sea.

The first railroad running to a port on the Arctic Sea is the continuation of the Vologda Railway, in Russia, which is now finished to the port of Archangel, on the southeastern corner of the White Sea and at the mouth of the river Dvina. This new line, which was opened some weeks ago, says The Engineering and Mining Journal, is nearly 400 miles in length. The Vologda-Archangel Railway passes for the most part through deserted or sparsely populated regions, or across "tundras" and marshes, which are sometimes 50 feet in depth. The whole nature of the country through which the new line passes was unfavorable to its construction. Marshes and patches of bog and swamp had to be filled in; the newly made embankments were continually giving way and had again to be built up until the necessary stability had been obtained. Six iron bridges and numerous bridges of wood were required. The wooden bridges are built upon piles driven, in some cases, to a great depth beneath the surface. The new line is of military as well as commercial importance, for it must play a leading part in the opening of the northern provinces of Russia. It will furnish an outlet, for instance, for the deposits of petroleum which exist in northern Russia, but have not been worked on account of the lack of transportation.

A NEW antiseptic of much value as a bactericide has been manufactured at Elberfeld from a formula given by Dr. Eichengrün, chemist at the factory of Bayer & Company. The preparation is called protargol, and is a compound of silver and protein. According to Dr. Benario, of Frankfort, a one per cent solution destroys the bacteria of anthrax and enteric fever. The preparation is also employed as a powder and as an ointment.

Miscellaneous Notes and Receipts.

Paper Hanging by Machine.—Paper hanging by machine is the latest achievement, says the Werkstatt. The arrangement used for this purpose is provided with a rod upon which the roll of paper is placed. A paste receptacle with a brushing arrangement is attached in such a manner that the paste is applied automatically on the back of the paper. The end of the wall paper is fixed at the bottom of the wall, and the implement rises on the wall and only needs to be set by one workman. While the wall paper unrolls, and, provided with paste, is held against the wall, an elastic roller follows on the outside which presses it firmly to the wall. When the wall paper has reached the top, the workman pulls a cord, whereby it is cut off from the remainder on the roll.

Paper floors are enjoying a steadily increasing popularity, which is readily explained by the many advantages they possess over wooden flooring. An important advantage consists in the absence of joints, whereby accumulations of dust, vermin and fungi dangerous to health are done away with. The new paper floors are bad conductors of heat and sound, and, in spite of their hardness, have a linoleumlike, soft feel to the foot. The costs are considerably lower than those of floors made of hard wood. The paper mass receives a small addition of cement as binder, and is shipped in bags, in powder form. The mass is stirred into a stiff paste, spread out on the floor, pressed down by means of rollers, and painted with oakwood, nutwood or mahogany color, after drying.—German exchange.

Fugitive Colors of Gems.—A remarkable fact is reported by the Journal für Goldschmiedekunst, viz., that the colors of precious stones are not permanent in the light. To give a chemical and physical explanation for this is difficult; for, although chemical reactions in solid bodies have been proved, one would not presume them to occur in the exceedingly hard minerals concerned. A ruby which had been left for two years in a light show window was found to be considerably lighter after this time had elapsed than a stone, previously of exactly the same color, which had been kept in the dark. Similar results were observed with emeralds and sapphires. Still more hasty than with these valuable colored gems is the action of light on the less expensive stones. Garnet and topaz differ in that the former becomes dim and dull, while the latter only turns lighter.

The Lakes of Cerium as Compared with Those of Iron and Tin.—Since the rare earths are now worked up in industry, cerium salts are obtained as a by-product, for which no use has been found so far. The author investigated whether and in what manner they might be employed as mordants in wool dyeing. He found that sheep's wool, on boiling with tartar and cerium sulphate, fixes the latter completely and firmly, but that the dyeings obtained on it do not possess any practical advantages over the other known methods. For the dyeing experiments the author used a tight cloth of sheep's wool which was heated about an hour with 4 per cent of cerium sulphate and 3 per cent of tartar, close to boiling, whereby the liquor was almost entirely exhausted. In a similar manner he dyed on tin lakes (mordanting with 4 per cent of tin salt and 2 per cent of oxalic acid) and iron lakes (12 per cent of green vitriol and 12 per cent of tartar, etc.) with logwood, alizarine, cochineal, Avignon berries, alizarine orange, sanders, and alizarine yellow. From the results compiled in a table it appears that, as regards resistance to acids, the tin lakes change their shades least (with the exception of the alizarine lake and alizarine orange lake), only becoming, as a rule, considerably lighter. As regards the acid-resisting properties of the cerium lakes, cochineal, Avignon berries and alizarine yellow are entirely fugitive, the original color almost returning. Alizarine, alizarine orange, and logwood changed their color entirely, the lake with logwood being so little acid-resisting that even the small quantity of tartaric acid remaining from the mordanting sufficed to prevent the formation of the lake in dyeing. It was necessary, therefore, to add a small quantity of ammonia for the neutralization of this tartaric acid, in order to attain the formation of the lake. The most acid-resisting is the cerium lake of sanders, while the iron lakes were found to be the least fast to acids. As regards the original color of the different lakes, it was found that the lakes of cerium are doubtless more approaching the iron lakes than the tin lakes, which is all the more to be observed as wool mordanted with cerium is in itself absolutely uncolored, while material mordanted with iron is known to be very strongly colored. As a general rule, the tin lakes are very bright and brilliant, while the cerium lakes and the iron lakes are dark; on an average the former have a redder tinge, the latter more of a blue one. In virtue of the similarity of cerium to the iron oxides and the sesquioxides respectively, and the dissimilarity of the lakes to those of tin and the monoxides respectively, one might regard as an established fact the assertion of modern chemistry that cerium is a sesquioxide.—Gustav Matschak in Mittheilungen k. k. Gewerbe Museum; Chemiker Zeitung.