THE CROTON RIVER DAM, NEW YORK WATER SUPPLY.

The Croton watershed, the source of the water supply of New York, is located from thirty to forty miles north of the city. It has a catchment area of 361·8 square miles, with an average yearly rainfall of 45·97 inches and an average yearly flow of 135,400,000,000 gallons.

The Croton reservoir, which forms the present water supply of the city, is located about six miles from Croton Landing, where the river of that name empties into the Hudson. It was constructed some fifty years ago and has a capacity of about 1,000,000,000 gallons. While this storage was ample for the population of 350,000 which New York contained at the time the dam was built, it is inadequate to the needs of the present population of 2,000,000. The new Croton dam, which is being built across the valley at a point 3¼ miles below the present dam, is part of a great scheme for improving the water supply by increasing the storage capacity to 30,000,000,000 gallons.

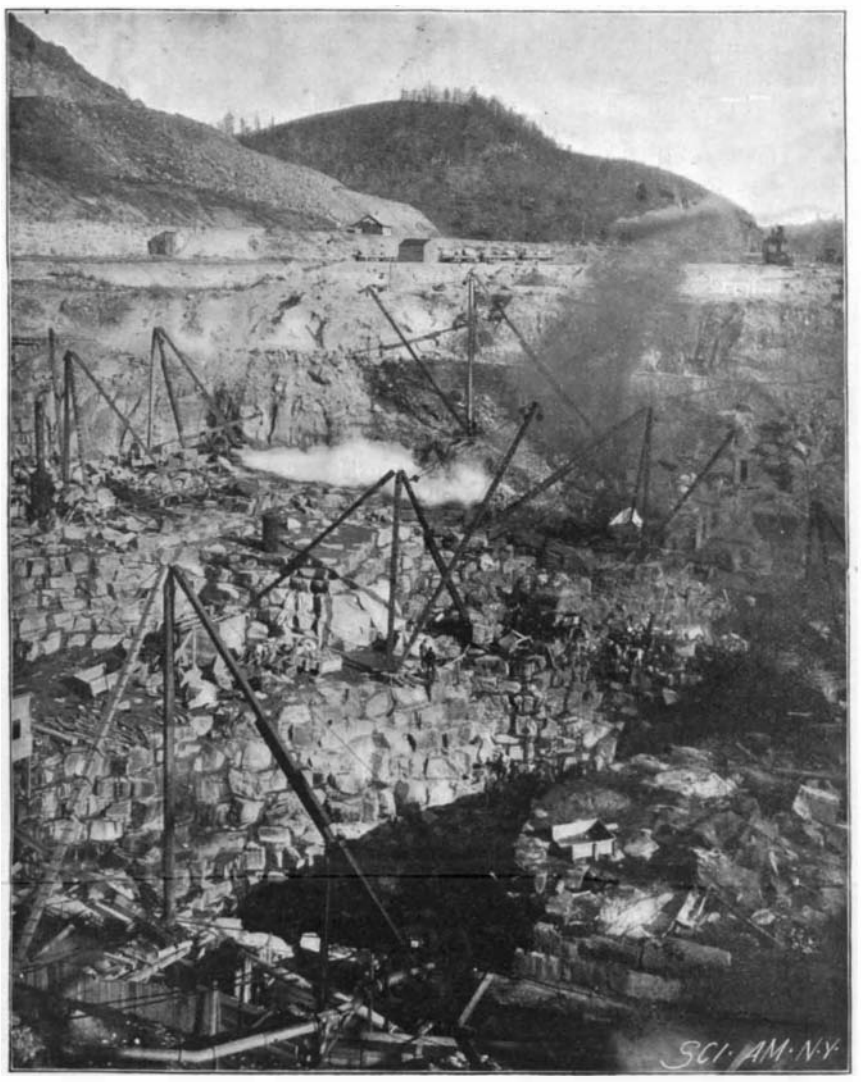
In many respects this is the most monumental work of its kind in existence. The total length of the dam will be over 1,000 feet and the spillway will extend another 1,000 feet upstream, parallel with the side of the hill. The total height of the masonry dam from foundation to crest varies, but where the foundations are deepest it will be approximately 300 feet. In excavating the vast trench for the foundations it was necessary to remove 880,000 cubic yards of earth, sand and gravel and 89,000 cubic yards of rock. When the great dam has been raised to its full height it will contain 640,000 yards of rubble masonry laid in cement, the whole work will have occupied thirteen years in construction and the cost will have reached some $4,500,000.

In the whole range of engineering works there is nothing that requires greater patience, care and skill than the erection of a colossal dam like this. It is no child's play to raise across the valley a giant wall that shall hold back the waters of a great lake, whose aggregate pressure tending to overturn the structure is 340,000 tons. Not only must the wall be given sufficient weight and sufficient breadth of base to resist the tendency of the water pressure to turn it bodily over and hurl it down the valley, but it must be rooted to the native rock of the hillside and valley bottom with such an intimate contact that not the most infinitesimal stream of water can percolate through. This would be a matter requiring care, if the water were but 10 or 20 feet deep; but at depths of 160 feet (the depth of the reservoir at the dam), where the hydraulic pressure is 5 tons on every square foot of the wall, the engineers must exercise the closest vigilance to see that the masonry is securely laid. Indeed, at the bottom of the foundations the hydraulic pressure would be about 9 tons per square foot or 125 pounds per square inch.

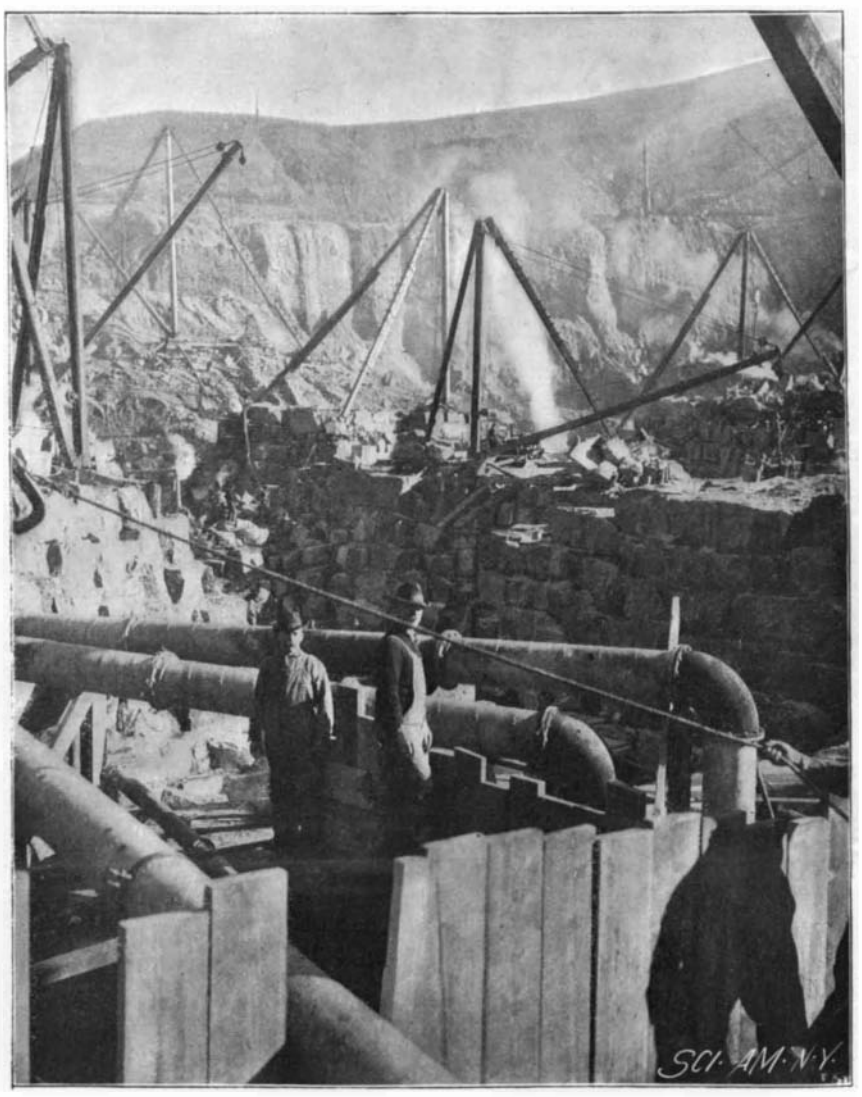
Under this head water would soon cut a large channel for itself through soft rock or any loose material. Hence it is necessary in building a dam like this to carry the foundations down to solid rock at every point. All the alluvial sand, gravel, etc., which has been deposited by the river in the course of ages has to be excavated until a firm, impervious quality of rock is laid bare. In the case of the Croton dam it was necessary to go down in some places 130 feet below the original river bed, and as the dam foundation is over 200 feet in width, the reader can form some idea of the vast chasm which has been dug out across the valley at this point.

Before the excavation was commenced, however, it was necessary to provide a temporary channel to convey the Croton River past the work (Fig. 3). To this end the toe of the hill on the north side of the valley was blasted away, and a channel was formed by constructing 600 feet of wall, 20 feet high, across the line of the dam, with two wing dams at each end of the wall—the wall and wing dams being built at a distance of 125 feet from the toe of the hill. A distant view of this temporary channel is shown in Figs. 2 and 7 and a view looking up the channel in Fig. 3. When the channel was complete, the north bank of the river was cut, diverting the waters into it and leaving the site of the dam dry.

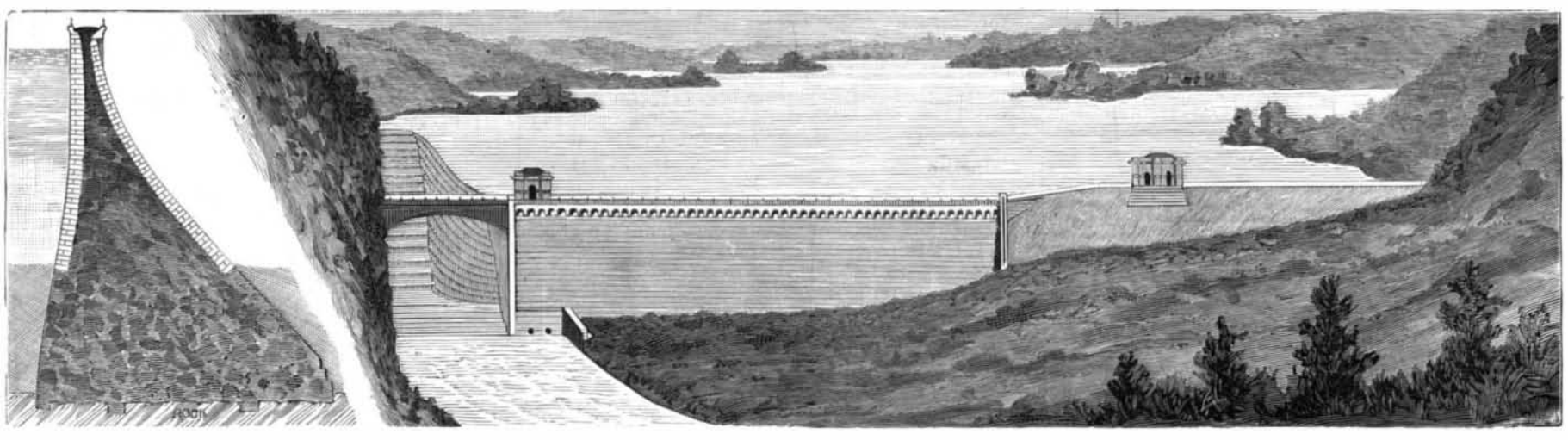
The excavation was carried on by the various well-known mechanical systems, such as suspended cableways, steam shovels and dredges. Tracks were run into the excavation and material was brought out and carried to the dumps above and below the dam by the train load. All loose material was carefully cleared away and in every case excavation was carried down to solid rock. Owing to the irregular lay of the rock, the depth of the foundation varies greatly, the lowest courses being as stated 130 feet below the bed of the river. After the surface of the rock had been cleaned, the work of building the rubble masonry commenced. The first four courses, as a rule, were laid in cement, the proportion of which was one part of Portland cement to two of sand. In the upper courses of masonry the proportions are one of American cement to two of sand. The rock is laid in large blocks about three feet in height,



4.—GROUP OF DERRICKS AT WORK IN THE GREAT EXCAVATION. THE TRAIN OF CARS IS AT LEVEL OF RIVER BED.



5.—DRAINAGE PIPES AND MASONRY ONE HUNDRED FEET BELOW ORIGINAL BED OF RIVER.



6.—THE COMPLETED DAM.

NEW YORK CITY WATER SUPPLY—NEW CROTON DAM.

SCIENTIFIC AMERICAN

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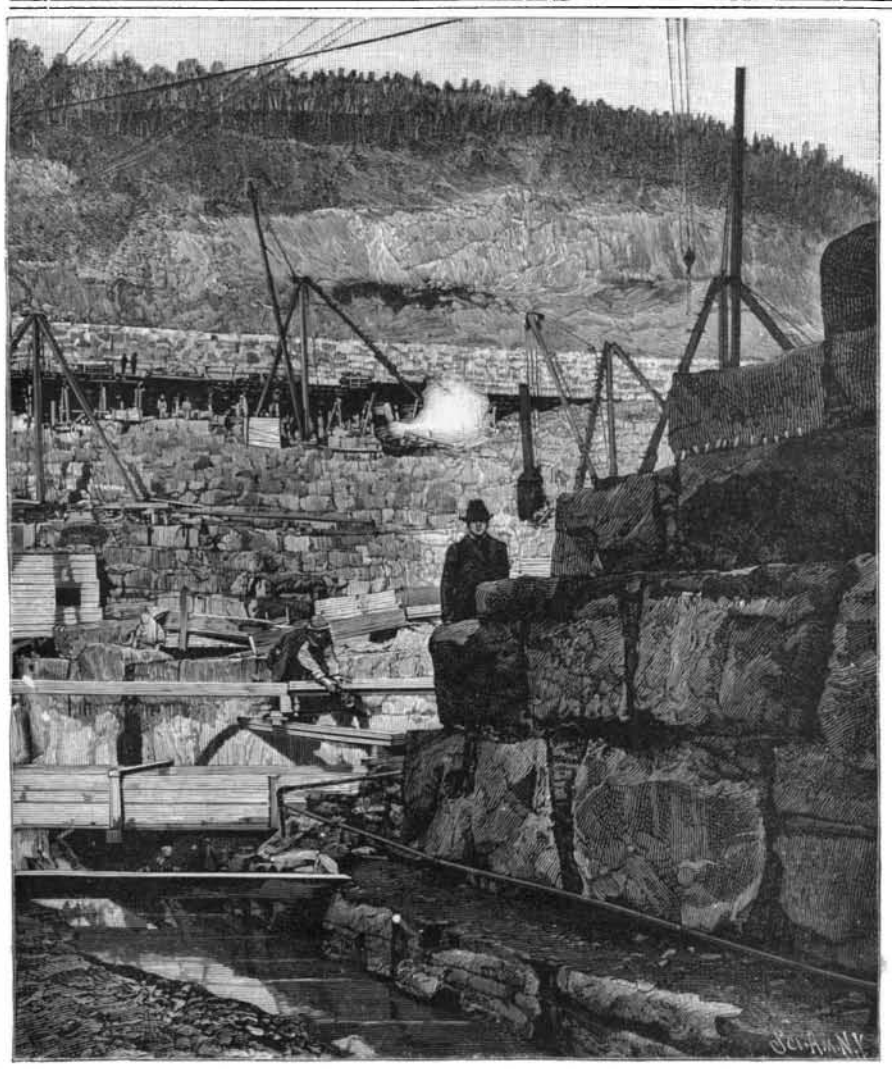
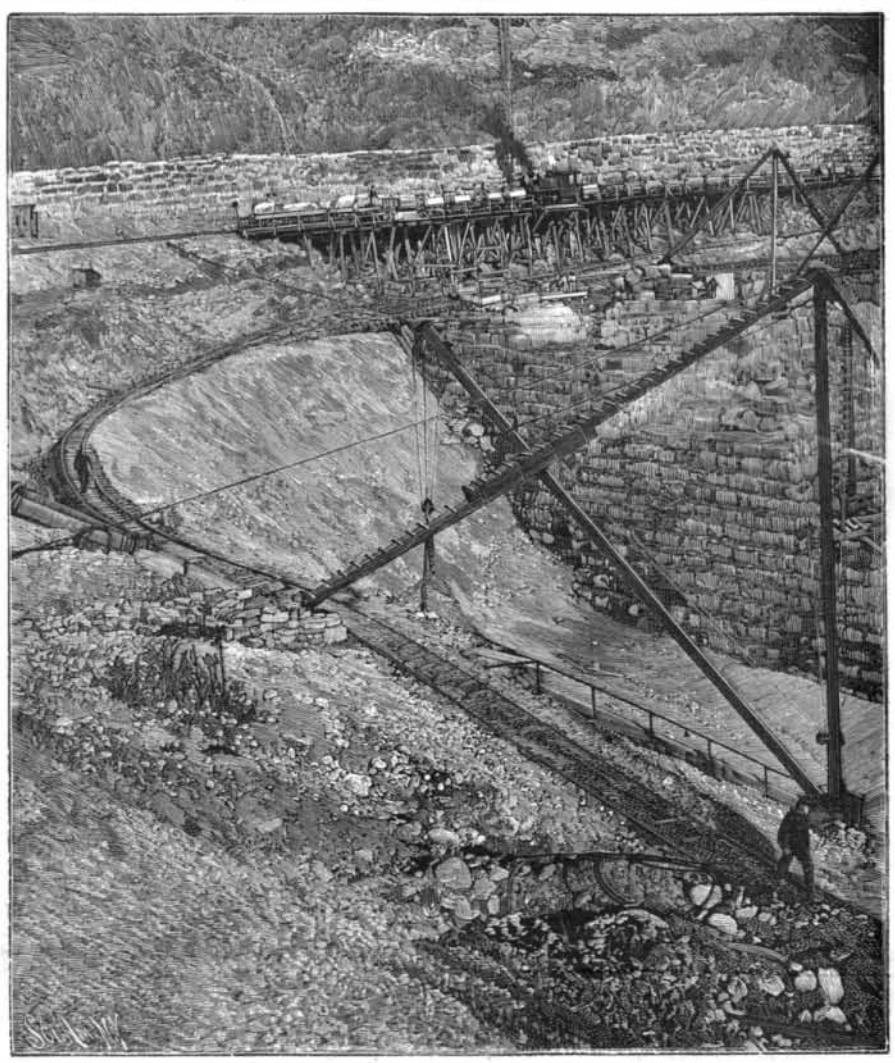
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

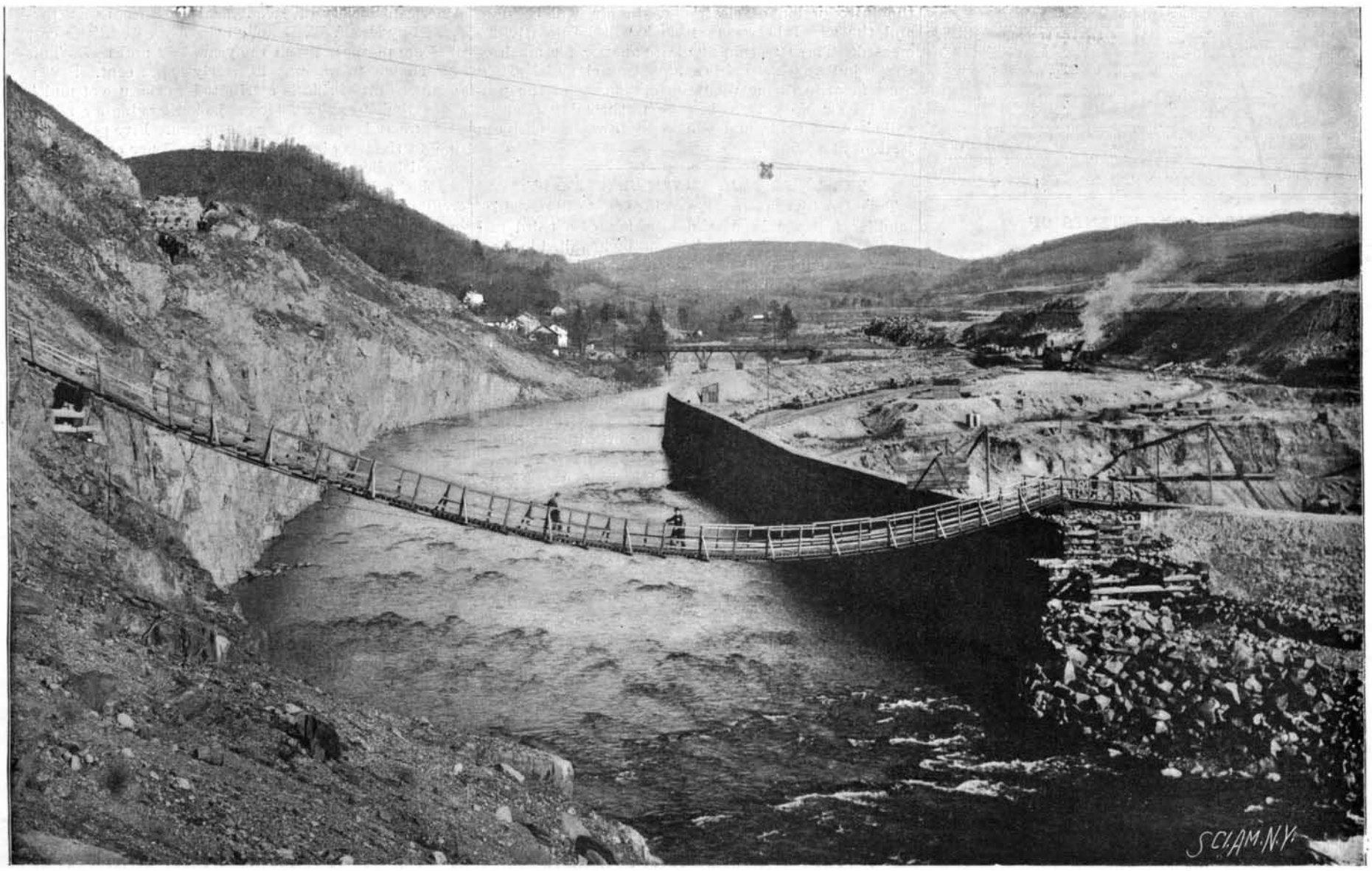
Vol. LXXVIII.—No. 6. ESTABLISHED 1845. NEW YORK, FEBRUARY 5, 1898. $3.00 A YEAR. WEEKLY.



1.—NEAR VIEW OF THE THREE-FOOT COURSES OF MASONRY.



2.—RAILWAY ACROSS END OF DAM, BRINGING ROCK TO OVERHEAD CABLEWAY.



3.—THE ARTIFICIAL CHANNEL AROUND NORTH END OF DAM.

NEW YORK CITY WATER SUPPLY—NEW CROTON DAM.—[See page 88.]

the joints being filled in carefully with smaller rock and cement. The rock is blasted from a neighboring quarry and brought to the dam by a railroad which runs across the north end of the dam below the wall of the temporary channel (see Fig. 2). Here the skips are picked up by a cableway, which stretches across the valley, carried over to the desired spot and lowered. The rock is then picked up and placed in position by derricks, of which a great number are scattered over the work. Some idea of the magnitude of the work may be gained when it is stated that the booms of the derricks, shown on the foundations in Fig. 7, are 50 feet long. In this general view of the foundations the level of the crest of the finished dam is indicated by a cross on the side of the hill.

The general appearance and cross section of the finished dam is shown in Fig. 6. It consists of three distinct portions. The first 400 feet on the south side of the valley is an earth dam, with an interior masonry core wall. Next to this is the masonry dam, 650 feet in length, which extends to within 200 feet of the north side of the valley. Here it bends sharply to the right and runs back up the valley parallel to the contours of the hillside for about 1,000 feet, finally turning into a junction with the hill. This last portion is the spillway or overflow. At the upper end the latter is comparatively narrow and shallow, but it widens and grows deeper toward the dam proper, of which it is really a prolongation. Its downstream face is formed in a series of large steps as shown in Fig. 6. The spillway is given these generous proportions with a view to accommodate any possible flood that might descend upon the lake. The Croton Lake will be only one of a series of smaller reservoirs scattered higher up in the hills. If any one of these should break, the Croton spillway could safely accommodate the sudden rush of water.

The upstream face of the masonry dam will be approximately vertical, but the other face will run back with a sharp inclination, rounding up to the perpendicular at the coping. The excavated material on the up and down stream sides will be filled in against the dam up to the original level of the river bed, and the two faces of the dam above this level will be finished in facing stone masonry in horizontal courses, laid everywhere at right angles to the face of the dam. It is interesting to note that the pressure of this great wall of masonry on the foundations is 18 tons per square foot.

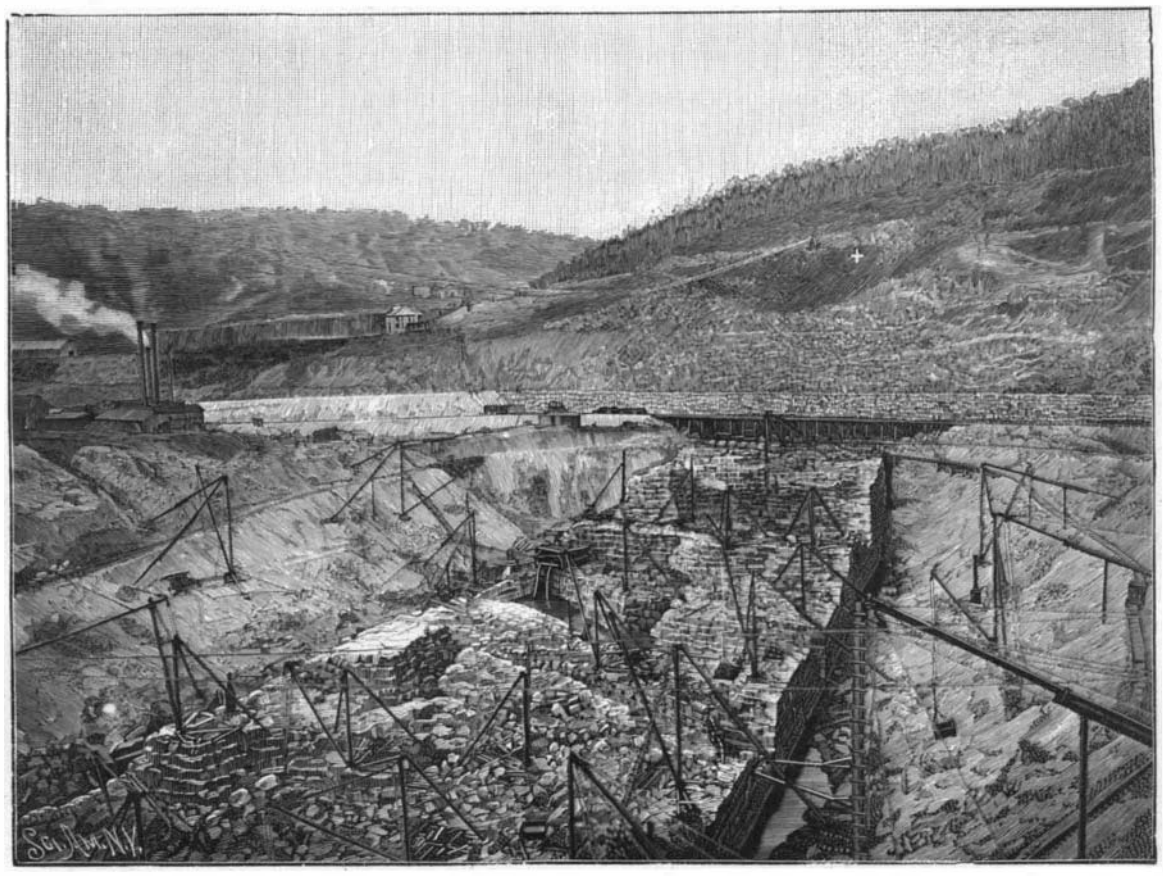
The earth dam is laid in 6 inch layers, from which all large stores are removed. Each layer is rolled with a grooved roller and watered. The water forms a bond and the roller packs the whole mass firmly together. The dead weight of the earth backing affords the necessary stability to resist the thrust of the water, the center core of masonry serving merely to render the dam watertight. This masonry core extends from the great masonry dam to the south side of the valley, and like it extends to solid rock both below the bed of the river and at the side of the hill. It is 18 feet thick at the bottom, 6 feet thick at the top, and its greatest height is about 230 feet. The downstream slope of the earth dam is sodded and the upstream slope is paved.

Along the crest of the dam extends an ornamental driveway which is carried across the spillway by a handsome steel bridge. The driveway is 18 feet wide, with a margin on each side for the necessary railing and coping, and the architectural appearance of the masonry dam is improved by an ornamental line of arches at the coping.

At the extreme north end of the dam will be built a blow-off gate house, for emptying the reservoir, should occasion necessitate it. It will be built out from the dam on the upstream side (see Fig. 6), its dimensions at the top being 35½ by 37 feet. The water will be blown off through three 48-inch pipes, which will lead through the masonry of the dam and discharge into the bed of the river. When the new aqueduct, which runs in a direct line and chiefly in tunnel from the old reservoir to New York, was built, it was provided with a gate house which is arranged so that it can take water from the new reservoir and lead it direct to New York by the new aqueduct. The old aqueduct runs down the south side of the valley from the old Croton dam and intersects the earth dam. At the point of intersection a gate house will be built whose intake will lead water from the lake at various elevations.

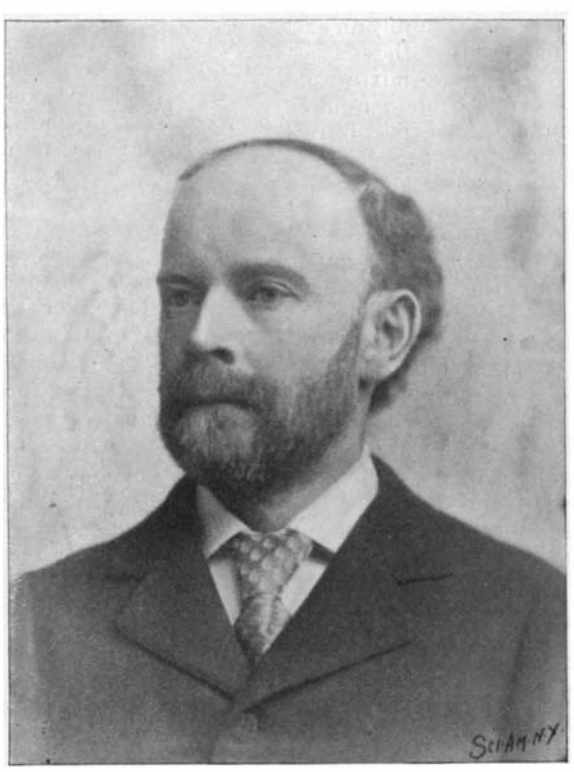
The crest of the Croton dam, 3¼ miles upstream, is 30 feet lower than the crest of the new dam. Hence, when the new reservoir is filled, the level of the lake will be 30 feet above the crest of the old structure The total water area will be about 8 square miles and the lake will extend as far as Croton Falls, fifteen miles up the valley.

The plans of this great work were drawn up by Chief Engineer Fteley, the recently elected President of the American Society of Civil Engineers, and the construction is being carried out under the immediate supervision of Divisional Engineer C. S. Gowan.

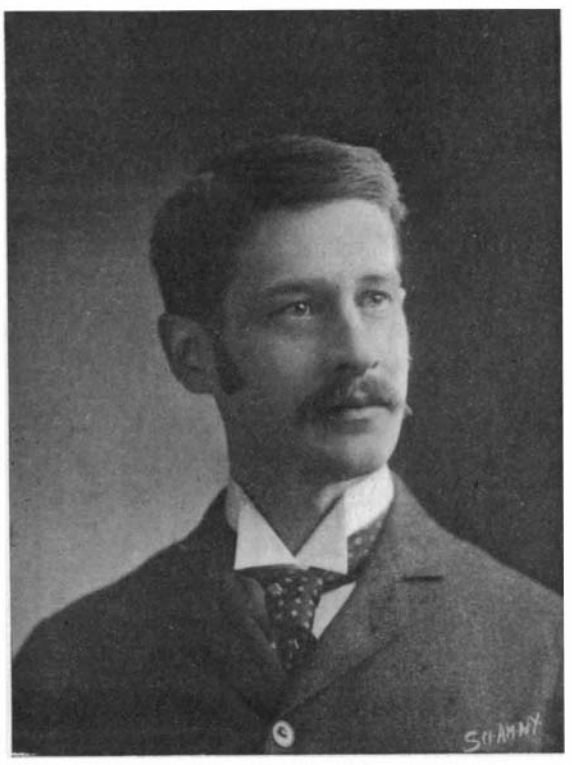


7.—GENERAL VIEW OF DAM FOUNDATIONS, SHOWING TEMPORARY CHANNEL AROUND NORTH END OF DAM.

Cross on hillside marks level of crest of dam.



HON. CHARLES H. DUELL, COMMISSIONER OF PATENTS.



JUDGE A. P. GREELEY, ASSISTANT COMMISSIONER OF PATENTS.

HON. CHARLES H. DUELL, COMMISSIONER OF PATENTS.

The United States Patent Office has been again favored with a Commissioner of known ability and probity. There is hardly a public man in the official life of Washington who is charged with more responsibility than the Commissioner, on whom rests the conservation of great interests. It is requisite that the incumbent of this office shall have a competent knowledge of practice before the Patent Office and be a lawyer as well. Mr. Charles H. Duell, of Syracuse, New York, who has been appointed by the President, admirably fulfills both of these qualifications. He has long ranked high as a practitioner in patent cases before the courts and he probably has few equals in this specialty. His practice has been extensive and has covered a great number of cases. He has attained a large degree of success, having had many cases where the interests involved were of large import. These he has handled with skill and prudence.

The appointment will probably mean a considerable financial sacrifice, as it will interrupt a lucrative practice and the position of honor to which he has been appointed is inadequately paid. Mr. Duell's appointment will be received with general public favor and it is considered one of the most fortunate of President McKinley's nominations. The new Commissioner was a candidate at the beginning of President McKinley's administration, but the latter wished to appoint his old personal friend, Congressman Butterworth. The death of Mr. Butterworth gave the President the opportunity of recognizing Mr. Duell's candidacy by nominating him.

Mr. Duell was born at Cortland, N. Y., in 1850; his father, R. Holland Duell, was four times sent to Congress, and in 1875 he was appointed Commissioner of Patents, which office he held for two years. Mr. C. H. Duell received a preliminary education in the Cortland Normal School; he then entered Hamilton College, from which he graduated in 1871. He was an honor man in his class and took several prizes. He has held some political offices honorably and acceptably to his constituents.

The inventors of the United States may feel sure that their interests will be looked after in a conscientious manner both in Congress and in the administration of the Patent Office.

JUDGE ARTHUR P. GREELEY.

The duties of the Commissioner of Patents are severe, and each new incumbent of the office must spend a considerable length of time in mastering the detail of the office. The manifold duties of the position render it essential that the Assistant Commissioner shall be thoroughly conversant with the administrative and judicial features of so great an establishment, so that he will be properly equipped to assist the Commissioner and take his place in the absence of his chief. In these respects the present incumbent, Judge Arthur P. Greeley, is well equipped for the responsible position of Assistant Commissioner of Patents.

Mr. Greeley is a graduate of Dartmouth College, in the class of 1883. He is a lawyer by profession, having been graduated from the law school of the Columbian University of Washington in the class of 1887, taking the post-graduate course at the same school the following year. The next year, 1888, he was admitted to practice in the District of Columbia.

In July, 1884, he entered the Patent Office as a fourth assistant examiner, as a result of his standing in the