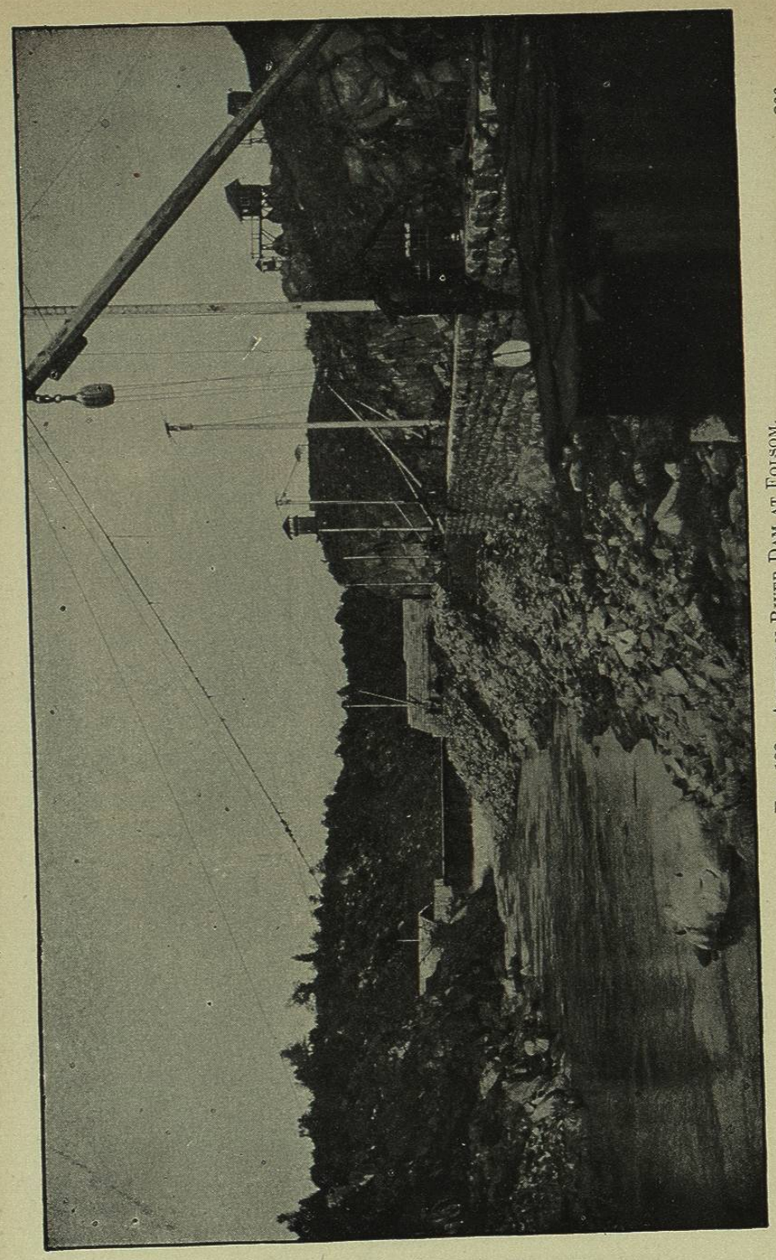

Fig. 188.—American River Dam at Folsom.

In passing the prison power-house a drop of 7.5 feet is utilized by six 87-inch Leffel turbines of the double improved type, and about 800 H.P. are developed at the maximum. The canal is 8 feet in depth throughout, the width below the prison power-house being 30 feet on bottom, 40 feet on top. Above the power-house the width is 10 feet greater. The grade is 1:2000, and the capacity of the canal about 1000 second-feet.

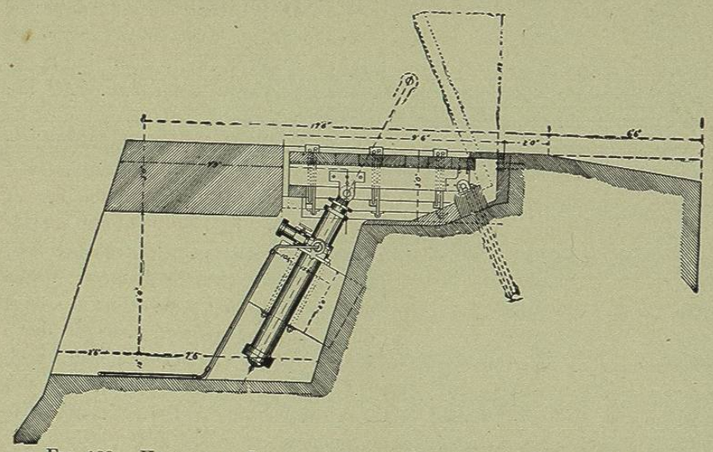

Fig. 189.—Hydraulic Jacks for raising Shutter on Folsom Dam.

The San Mateo Dam, California.—Doubtless the most enormous mass of masonry of any sort in the West, if not in the entire United States, is the great concrete dam erected on San Mateo Creek, 6 miles above the village of San Mateo, California, by the Spring Valley Water-works of San Francisco, to impound water for the supply of that city. The dam ranks among the highest and most costly of the world, and was erected in 1887 and 1888.

It was projected to reach to a height of 170 feet, at which the top width was to be 25 feet and base width 176 feet, but construction was suspended at the height of 146 feet, or 34 feet below the ultimate height. When finished the top length will be 680 feet. It has a uniform batter of 4 to 1 on the up-stream face, while the lower slope, beginning with a batter of $2\frac{1}{2}$ on 1 near the top, curves with a radius of 258 feet to near the bottom, where the batter is 1 to 1. The dam is arched up-stream with a radius of 637 feet.

It is built throughout with concrete, made of broken stone, beach sand, and Portland cement. This material was chosen because of the difficulty of securing rock in the vicinity suitable for rubble masonry. The stone was quarried in the immediate vicinity, and occurred in small irregular nodules,

frequently so coated with clay and serpentine as to require it to be thoroughly washed before it was fit for use. After crushing, it was passed through revolving cylindrical tumblers, where a constant stream of water was maintained to carry off the mud and tailings, which passed off through a flume and dropped to the stream-channel, where the deposit from these washings covered several acres to a considerable depth. The proportion of waste was large. The sand used in the concrete was obtained from the sand-dunes of North Beach, San Francisco, where it was loaded on cars, hauled one mile, and dumped into barges, then towed 25 miles up the bay to a landing opposite San Mateo, and thence hauled 6 miles by wagon to the dam. All the materials were thus unusually expensive.

The concrete was mixed in a battery of 6 cubical iron mixing-machines revolved by steam-power. It was delivered to the work by a double-track tramway on a high trestle carried part way across the canyon at the level of the top of the dam on the lower side, as shown in Fig. 190. The cars on this tramway were pushed by hand and dumped into hoppers let into the floor between the rails, leading to vertical pipes, 16 inches in diameter, which extended down to platforms that were placed from time to time at a level with the top of the work as as it progressed. The concrete dropped down these pipes, striking on steel plates, from which it was shoveled into wheelbarrows and trundled to the place of use. The height of this drop was sometimes as great as 120 feet, but no injury resulted to the concrete, or to the men shoveling it as it fell. The concrete was mixed in the proportions of 1 part cement to 2 parts sand, $6\frac{1}{2}$ parts broken stone, and $\frac{2}{3}$ part water by measure. It was moulded in cyclopean blocks of 200 to 300 cubic yards each, with numerous offsets ingeniously dovetailing the blocks together, and every possible precaution was taken in the joining of the successive portions to secure an absolute bond. The surfaces of the blocks after the forms were removed were roughened with picks, swept and washed clean, and grouted with pure cement before concrete was placed against them. The result has been very satisfactory; the dam is almost absolutely water-tight, although some moisture does find its way through and appears in spots on the lower face. No settlement or expansion cracks are visible, and the work has the appearance of being absolutely homogeneous. Figs. 192 and 193 show the general method of forming the blocks and preparing them to receive fresh concrete, and Fig. 194 is a general view of the dam taken at the time of the visit of the American Society of Civil Engineers in Annual Convention, July, 1896. Plans and sections of this dam are shown in Fig. 191. At the 170-foot level the reservoir will have a capacity of 29,000,000,000 gallons, or 89,000 acre-feet. The present capacity is approximately 20,000,000,000 gallons.

The entire volume of the dam is approximately 139,000 cubic yards.

When the dam is extended to its ultimate height it will be necessary to

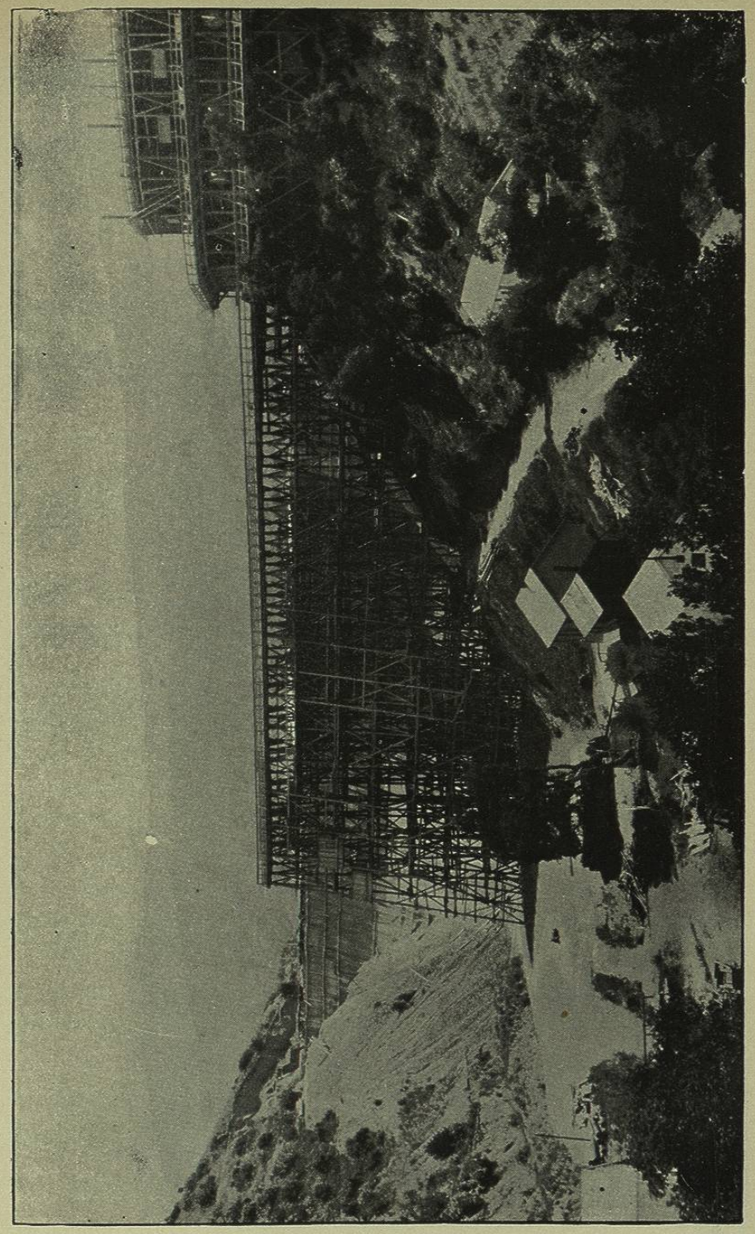

FIG. 190.—PLANT FOR MIXING AND HANDLING CONCRETE AT SAN MATEO DAM.

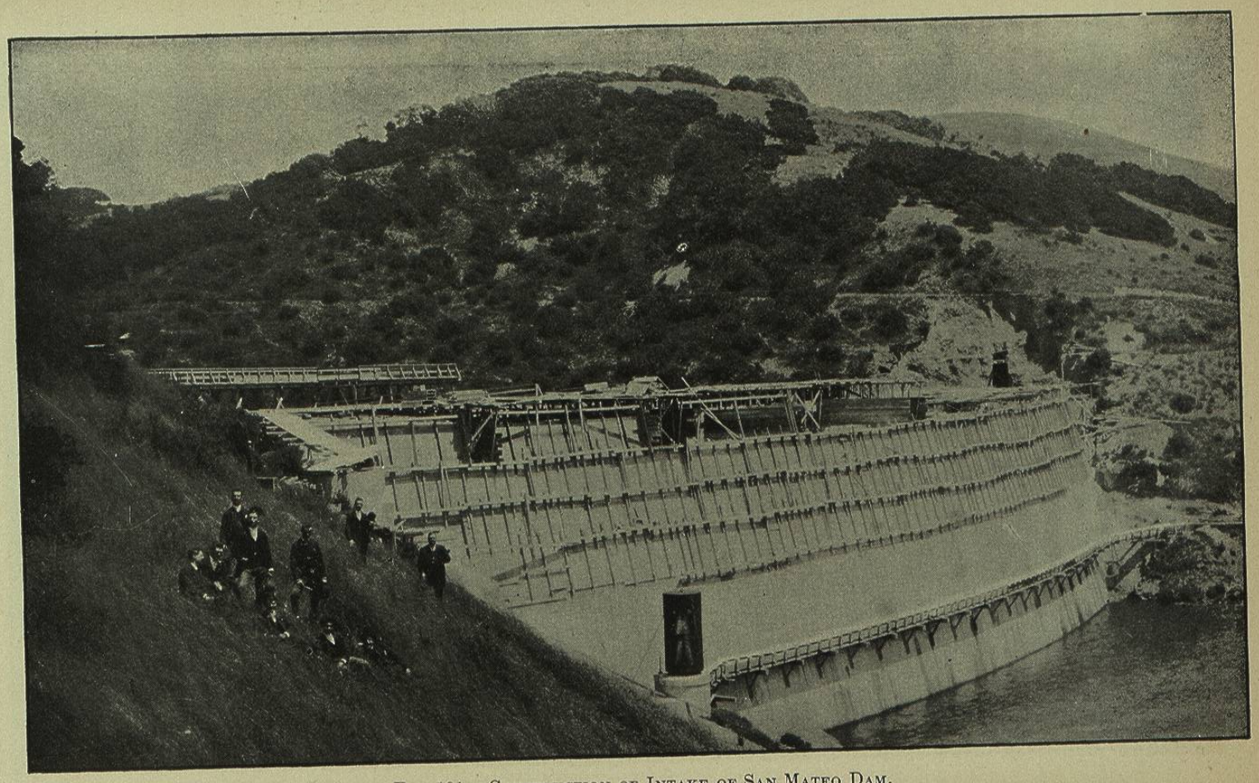

FIG. 191.—CONSTRUCTION OF INTAKE OF SAN MATEO DAM.

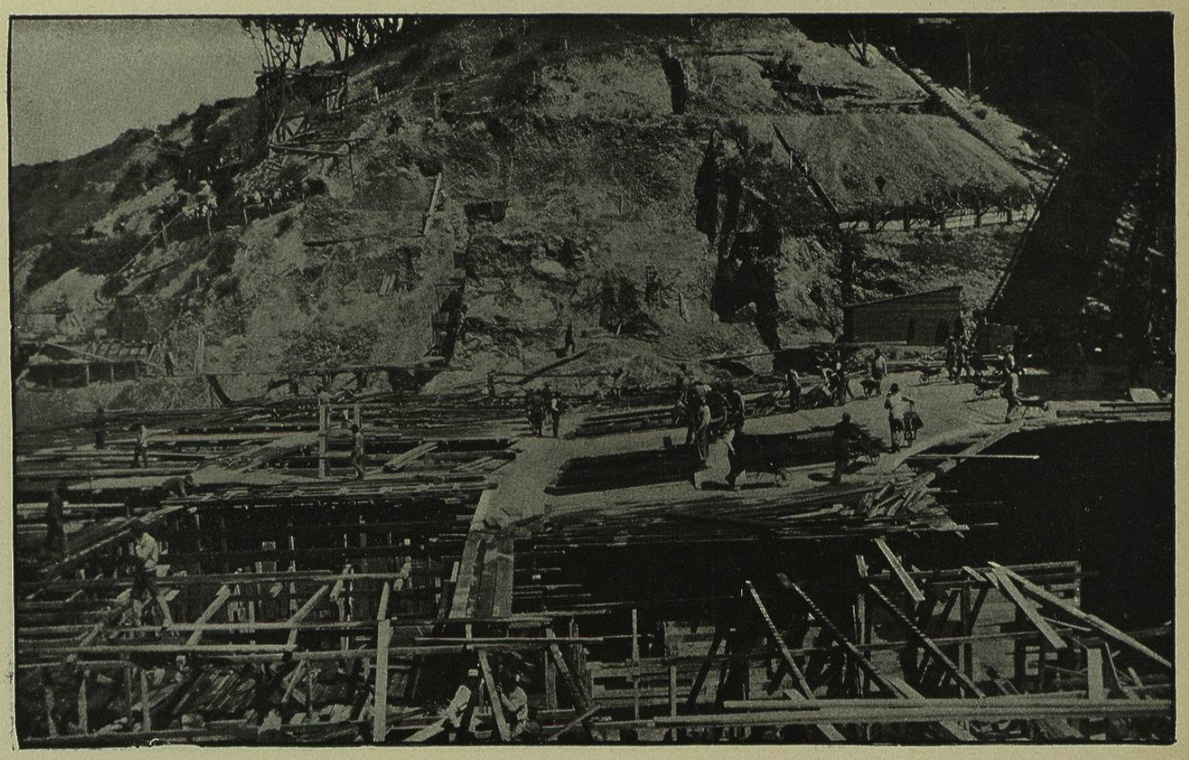

FIG. 192.—MOULDS FOR CONCRETE BLOCKS, SAN MATEO DAM.