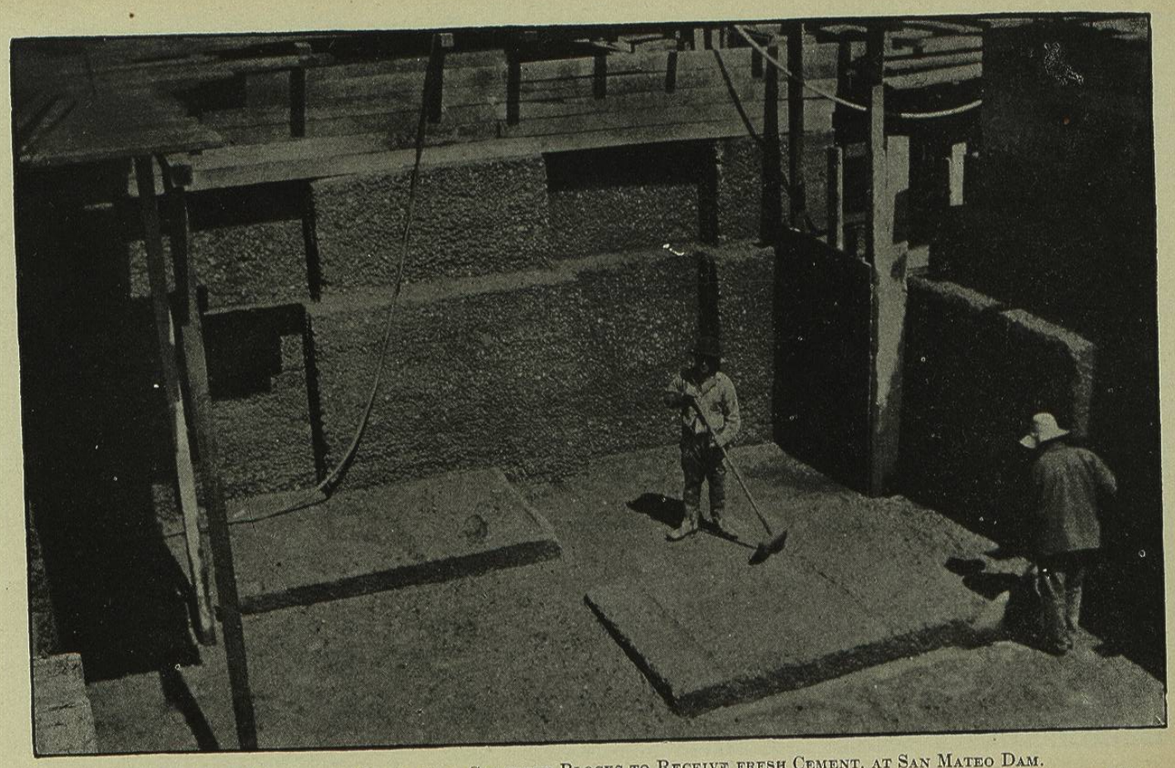
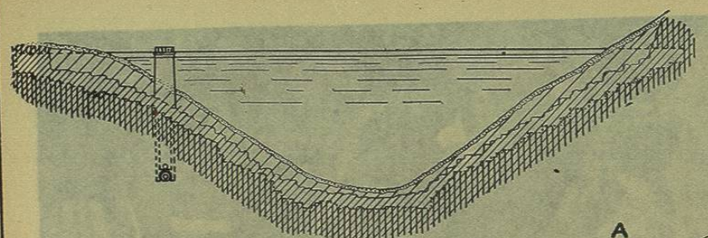
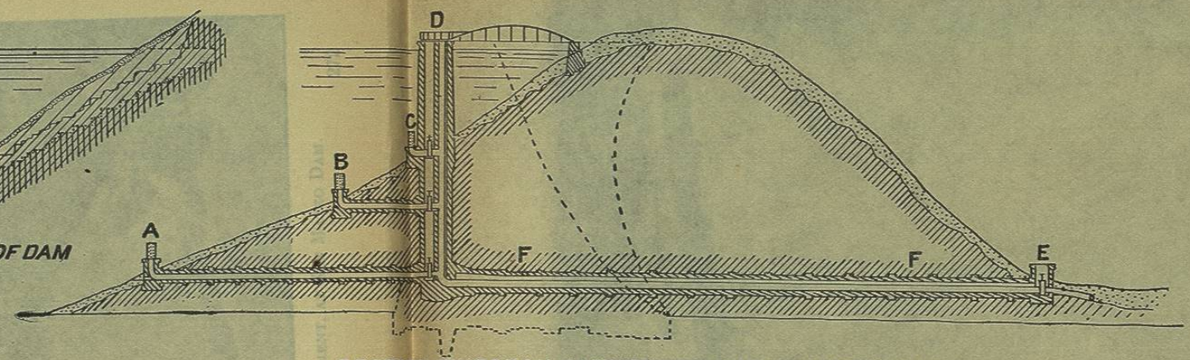


Fig 193.—Roughening Surface of Concrete Blocks to Receive fresh Cement, at San Mateo Dam.

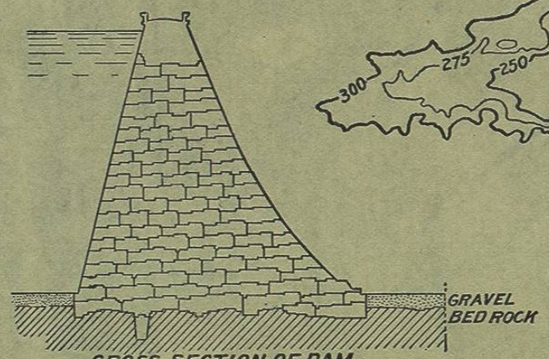


LONGITUDINAL SECTION OF DAM

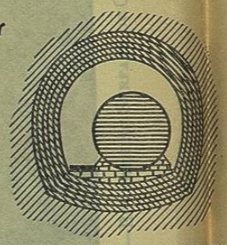


SECTION THROUGH GATETOWER AND OUTLET TUNNEL

CRYSTAL SPRINGS RESERVOIR

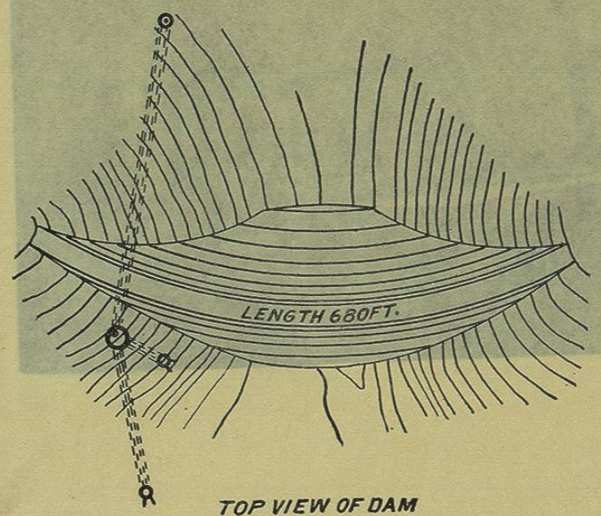


CROSS SECTION OF DAM

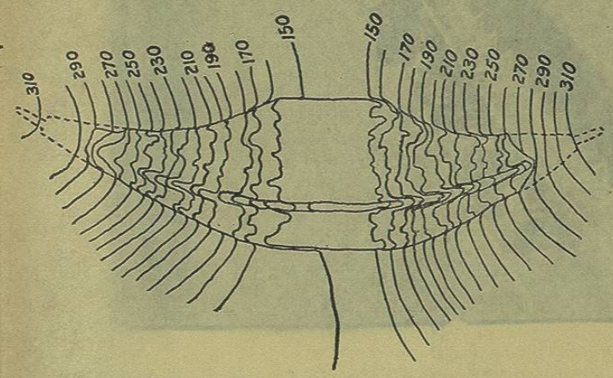


OUTLET TUNNEL F-F

PLAN SHOWING LAYER OF CONCRETE BLOCKS



TOP VIEW OF DAM



ROCK EXCAVATION FOR FOUNDATION OF DAM

FIG. 195.—PLANS AND SECTIONS OF SAN MATEO DAM AND MAP OF CRYSTAL SPRINGS RESERVOIR.

[To face page 273.]

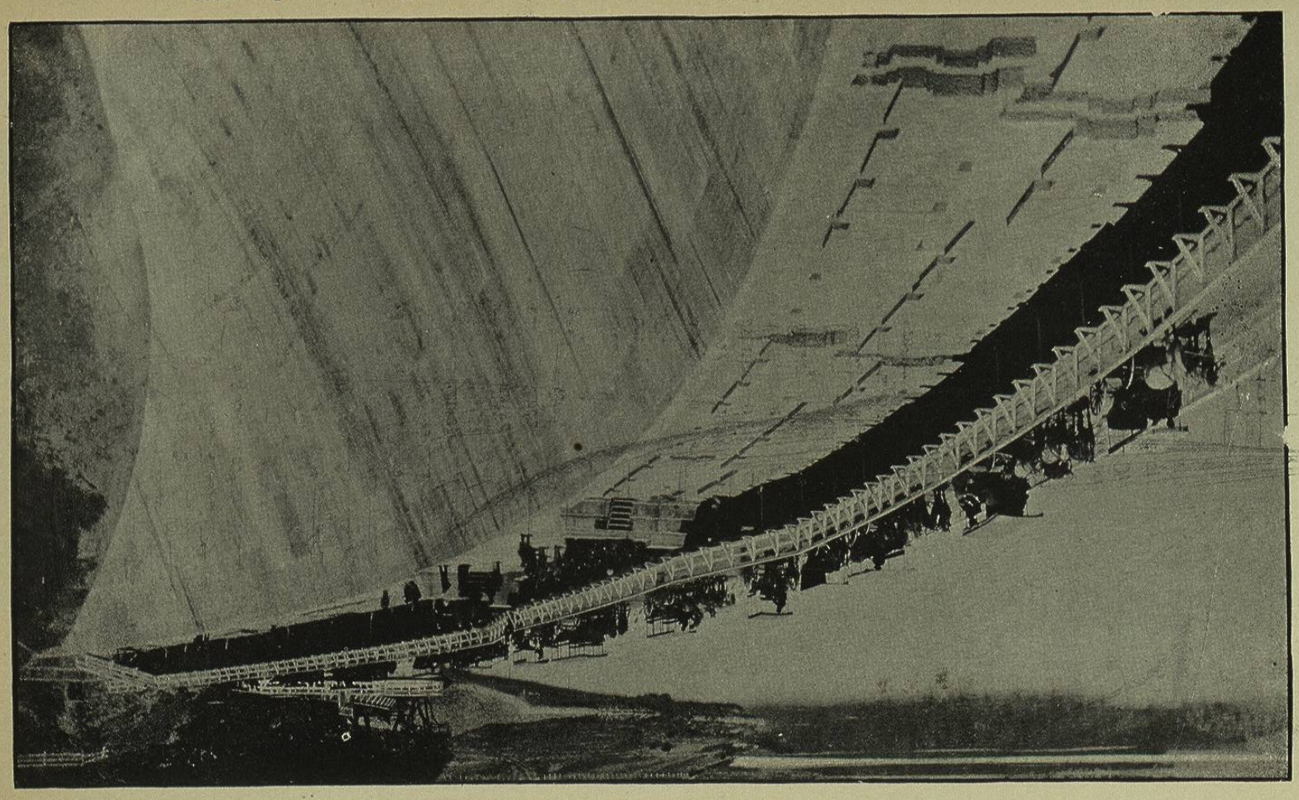


FIG. 194.—SAN MATEO DAM BEING INSPECTED BY AMERICAN SOCIETY OF CIVIL ENGINEERS, IN JULY, 1896.

close a gap in the ridge a short distance north with a wall about 25 feet high. The outlet to the dam is a tunnel 390 feet long, driven through the hill on the north side of the channel, through which a 54-inch riveted iron pipe is laid. The tunnel is 7½ feet wide inside the lining, and of the same height, and is lined with four courses of brick, 21 inches thick.

The tunnel is intersected by a brick-lined shaft, 14 feet clear diameter, placed just inside the dam in the reservoir. Inside this shaft is a stand-pipe connecting with the main outlet-pipe. Three branch tunnels, carrying large pipes, open out from the reservoir to this stand-pipe, each pipe being controlled by gate-valves that are placed in the main shaft. This is an admirable form of outlet, as all the pipes from the shaft are accessible to inspection and repair. The ends of the tunnels under water have plain cover-valves over elbows, and are provided with fish-screens that are put into position from floating barges. A main pipe, 44 inches in diameter, leads from the dam to San Francisco. The present crest of the dam is 281 feet above tide-level.

When the reservoir is filled it submerges the old Crystal Springs reservoir and dam, the latter being an earth structure which did service for many years until superseded by the new dam. A smaller reservoir, that formerly supplied the town of San Mateo, was also obliterated from view, and the water at highest level will extend up the valley of the north arm of the creek nearly to the toe of the San Andreas dam.

The old Crystal Springs reservoir had a tributary watershed of 14 square miles, which yielded a mean annual run-off of 319 acre-feet per square mile during the eight years from 1878 to 1886. The mean rainfall during that period was 34.95 inches. This run-off is equivalent to a mean of 14.4% of the mean rainfall, the maximum having been 34% and the minimum 0.5%.

The Pilarcitos and San Andreas watersheds, whose catchment is retained by earthen dams, receive a much higher precipitation, especially the former, which is more directly exposed to the saturated wind-currents from the ocean. The average precipitation over all the Spring Valley Water Co.'s sheds, during the seven years from 1868 to 1875, was 43.5 inches, from which the mean run-off was 35.5%, including loss by evaporation. These watersheds are partially wooded, undulating pasture-lands, uncultivated, covered with deep soil, and clothed with native grasses that spring up annually from seed and have little permanent sod. The results of the measured catchment from these areas indicates that, in general terms, on watersheds of this character from 20 to 35 inches of rainfall are annually taken into the soil and absorbed in plant-growth and evaporation.

Pacoima Submerged Dam, California.—One of the most novel and interesting masonry dams erected for impounding water in California, where so many novelties and experimental works have been carried out, is a slender

little reservoir wall built across Pacoima Creek, in the San Fernando Valley, 20 miles north of Los Angeles, for the purpose of forming an underground reservoir, whose storage capacity consists solely of the voids in the gravel-bed filling the valley of the stream.

The creek drains a watershed whose area is 30.5 square miles above the point where it issues from the mountains. Here it flows over exposed bed-rock, and the normal summer flow, which diminishes gradually from about 100 to less than 10 miner's inches, is entirely diverted by a pipe-line and used below for irrigation. The dam in question is located 2½ miles further down, where the channel of the stream is contracted to a width of 550 feet by a ledge of sandstone which crosses it at about right angles. Between the dam and the mouth of the canyon is a continuous bed of gravel, in places half a mile wide, which, though lying on a heavy grade, constitutes the storage-reservoir. The dam was constructed by excavating a straight trench (shown in Fig. 196), 6 feet wide, from side to side of the channel, down to and into the sandstone bed-rock. In the center of the trench a wall of rubble masonry was laid, 3 feet wide at base, 2 feet at surface, using the cobbles excavated from the trench, and a mortar of Portland cement and sand. The mistake was made of not filling the entire width of the trench with concrete, thoroughly rammed between the side walls, which would probably have insured satisfactory water-tightness. As it was, the space each side of the wall was refilled with gravel, and the wall was not thick enough or sufficiently well pointed to be entirely water-tight. The general height of the wall is 40 feet, the maximum being 52 feet. Plan, profile, and section of the dam are shown in Fig. 198. Two gathering-wells are provided in the line of the wall, each 4 feet inside diameter, reaching from bottom to top.

Three lines of drain-pipes, 8 and 10 inches diameter and made of asphalt concrete, laid with open joints, are placed inside the dam leading to the wells, the function of which is to gather the water and feed it to the wells. Outlet-pipes 14 inches diameter, one from each well, lead to either side of the valley. These are placed 13 feet below the top of dam and connect with a main leading to the pipe distributing system supplying the irrigated lands. When the reservoir is drained down to the level of these outlets further draft is made by pumping, which is required for about 100 days during late summer and fall.

The cost of the dam is given at $50,000, and the volume of masonry was about 2000 cubic yards. It is a piece of amateur work, built without engineering advice, but it serves a useful purpose, though not at all commensurate to its cost. It is, however, a type of dam that may be applicable to other localities more naturally favorable than this.