wet earth, is built to a height of 4 feet. Well constructed, the levees last indefinitely. In time vegetation springs from the outside of the adobe, and its verdure adds to the picturesque aspect of the place.

THE BAROSSA DAM, SOUTHERN AUSTRALIA.

BY EMILE GUARINI.

The dam recently finished at Barossa, near Gawler, in Southern Australia, is entirely of concrete and the largest of the kind that exists in Australia. This gigantic work, which presents peculiarities other than that of its dimensions, was constructed under the supervision of Alex. B. Moncrieff as chief engineer.

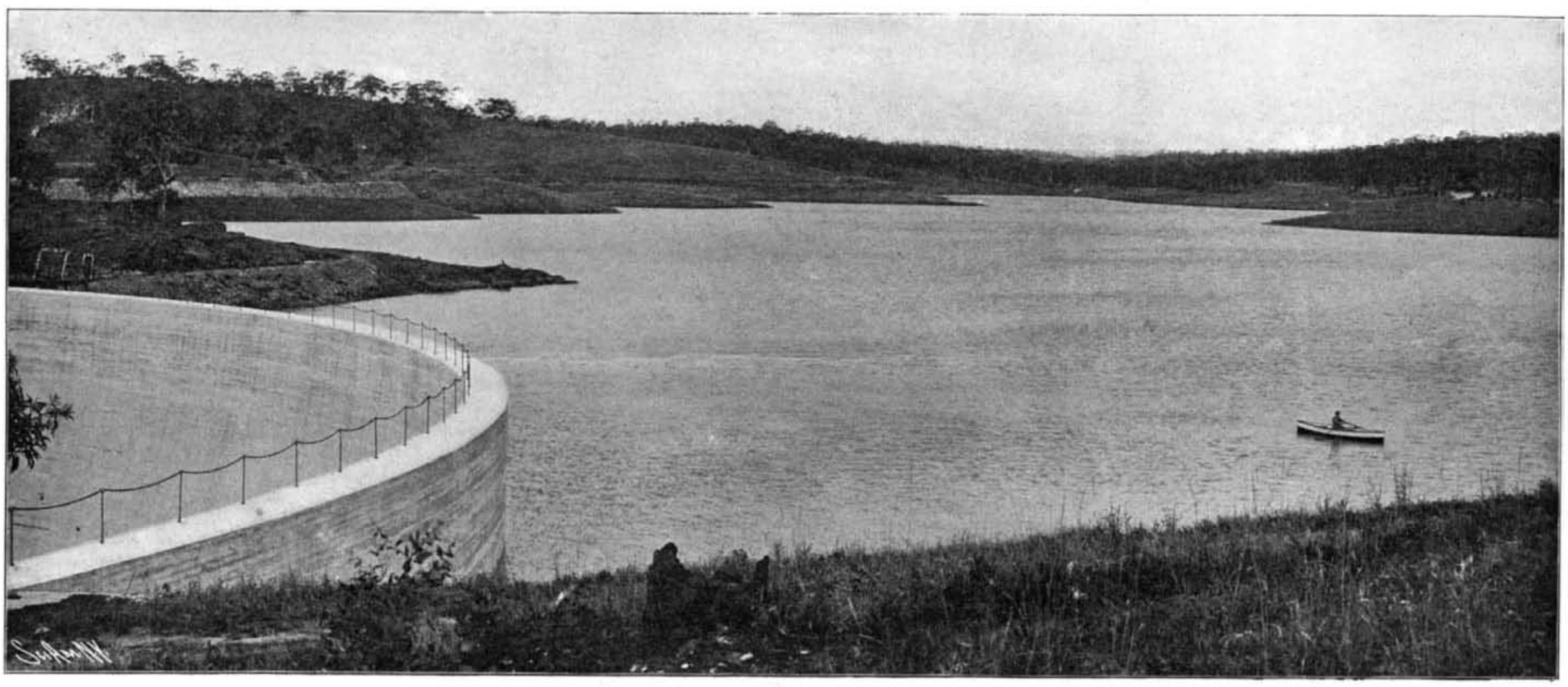
The site of the dam was selected at a point at which one of the banks presented a nearly perpendicular cliff 98 feet high, and at which the opposite bank, of an easy slope, formed a sort of spur, that projected into the bed of the river.

The dam is constructed entirely of concrete without any facing of dressed stone or rubble. Nevertheless, blocks of undressed gneiss were placed in the concrete, with intervals between them of at least six inches. At about $14\frac{3}{4}$ feet from the top of the dam, such blocks ceased to be employed because of the slight thickness of the dam at this part, and rows of curved rails, connected by fish plates, were imbedded in the concrete. A total weight of 40 tons of rails was worked into the dam in this manner. The dam is of the curved type, presenting its convex face to the water. The vertical section of the dam is triangular. The upstream facing is vertical and the downstream inclined. The height is 95 feet above the old level of the river. The thickness is but 36 feet at the base of the foundation in the thickest part, and 4.5 at the top. It was possible to make the dam of such slight thickness owing to the curved form that was given it in the plan and which gives to the structure all the resisting qualities of the arch. In plan, the curve of the upstream face is struck on a radius of 200 feet, over an angle of 135 deg. 20 min. and through an arc of 470 feet. The cost of the work ($849,400) is relatively very low, and, thanks to the reduction in thickness and the arched form, it is very much less than that of a dam having a profile sufficiently thick to resist the thrust of the water by its mass alone. The cost of such a dam was at first estimated at $1,145,800.

After the work was completed, the total cubical contents of the dam was estimated by precise methods, and was found to be exactly equal to that deduced from the weight of the materials that entered into the construction.

Since the dam was put in service, an observation made during six days, in which the temperature varied by 31 deg., has shown that, with such variation, the pitch increases by 0.8 of an inch, corresponding to a $1\frac{1}{2}$-inch elongation of the arc. During the construction the temperature varied from —2 deg. to +55 deg. During the time of frosts, the masonry was covered with straw matting and fire was kindled that produced much smoke at the top of the masonry, doubtless to prevent the loss of heat by radiation. In this way the newly-laid concrete was very efficiently protected against the cold. The intention was to fill the reservoir in measure as the construction proceeded; but the irregular risings of the water of the river did not permit of this.

The concrete employed in the work was always mixed with the greatest care and in small quantities at a time. The mixture was made by weight and automatically. Before the composition of the concrete for one part or another of the dam was decided upon, experiments were always made in order to make sure of the impermeability of the material to the pressure that it had to support. The sand and broken stones were carefully washed, and, as for the cement, that was well aerated previous to being employed. The concrete was mixed in quantities of 28 cubic feet at a time, and immediately deposited in layers upon the work, the beds being arranged in such a way that the surfaces of separation corresponding to each deposit, and forming of joints, as it were, of this sort of bond, never presented any continuity either in a vertical or a horizontal direction.



View Along the Crest Showing Curved Form of the Dam.

THE CURVED CONCRETE DAM AT BAROSSA, SOUTH AUSTRALIA.

THE NEW BLACKWELL'S ISLAND BRIDGE.

In common with the other large bridges spanning the East River, the Blackwell's Island Bridge has had to pass through a period of preliminary investigation and futile financiering before it was finally taken hold of by the city, its plans definitely determined upon, and construction actually begun. The first franchise for a bridge at that point was granted to a private citizen in 1884, but fourteen years passed away before the final plans as drawn up by the Bridge Commissioner were adopted. The crossing extends from Manhattan Island on the blocks bounded by Avenues A and B, and by 59th and 60th Streets, and extends across the two channels of the East River and over Blackwell's Island to the Long Island shore.

As originally planned, the structure was to consist of a cantilever bridge of five spans on four piers, one pier on the Manhattan shore, two intermediate piers on the shores of Blackwell's Island, and the fourth pier on the Long Island shore. Ground was broken in September, 1901, but the work was carried along with such indifferent speed that by January, 1902, only $42,000 had been expended. At that time the plans of the superstructure were revised by the Bridge Commissioner and drawn up on the following dimensions: First, starting from the Manhattan side, there is a shore span of the main cantilever, 469 feet 6 inches in length; then the main river span 1,182 feet in length; next is the span across Blackwell's Island, 630 feet in length; then follow the span over the easterly channel, 984 feet long, and the Long Island shore span, 459 feet long.

From the above dimensions it will be seen that the Blackwell's Island Bridge will include one of the longest cantilevers in existence, the well-known Forth Bridge being the most notable of this type of structure, with two main cantilever spans, each 1,710 feet in length. The superstructure consists of two lines of trusses spaced 60 feet from center to center. The top chord is built up of nickel-steel eye-bars which vary in depth from 12 inches to 8 inches, according to the stresses that have to be provided for in any given section of the bridge. The bottom chord will be of the regular box construction of the kind that is now universally used for compression members in long-span bridges of this type. The floor system will be supported upon massive transverse floor beams, which will be carried out for a distance of 13 feet beyond the main trusses to provide a roadway for two lines of trolley cars, one on each side of the bridge, these extensions forming cantilever or bracket supports for such roadways. Between the floor beams, running in longitudinal lines throughout the whole length of the bridge, will be worked in a series of parallel plate-steel stringers, fifteen in all, and above these stringers will be placed a continuous steel buckle-plate floor. On the main floor of the bridge provision will be made for four trolley tracks, two on the inside of, and immediately adjoining, the trusses for the use of the overhead trolley cars, and two, as above mentioned, on the outside of the trusses for the use of the underground trolley cars. Between the overhead trolley tracks between the main trusses will be a broad roadway for vehicles having a clear width of 36 feet. This arrangement of the vehicle roadway is something new in New York bridges, where hitherto they have been separate, and placed on opposite sides of the axis of the bridge. The new method will have the advantage of providing a very broad and impressive thoroughfare, that will add greatly to the sense of spaciousness and dignity in this structure. At a height of 15 feet above the main floor of the bridge will be a second floor or deck, supported on transverse floor beams, which will be attached to the vertical posts of the bridge at each panel-point, the connection being stiffened by knees worked in below the point of attachment. On this upper deck provision will be made for two foot walks, each 11 feet wide and placed immediately next to the main trusses, and between them will be two tracks for the use of the cars of the elevated railways. Each tower will consist of a pair of massive legs of a general box section, each leg being battered to give greater lateral stability against wind pressure. The two legs of the tower will be heavily sway-braced, and at the top of the towers they will be connected by a deep latticed truss, and by an arch designed to harmonize from an architectural point of view with the general construction of the whole bridge.

Considerable interest attaches to the eye-bars, inasmuch as they are of the same type as the much-debated eye-bars designed by the late Bridge Commissioner for the new Manhattan Bridge. They are to have an ultimate strength, annealed, of 90,000 pounds to the square inch, an elastic limit of 54,000 pounds to the square inch, and an elongation of 13 per cent in 8 inches with 35 per cent reduction of area. The great toughness of the material is shown by the severe tests to which it will be subjected. Thus an annealed test piece 4 inches wide or more must be bent cold through 180 degrees, around a pin whose diameter is twice the thickness of the test piece; while the unannealed specimen must bend through 180 degrees, around a pin whose diameter is three times the thickness of the test piece; and this must be done without any fracture appearing in the metal.

This fine structure, in addition to carrying the load due to its own weight, will have to support a live load of 6,300 pounds per foot run of the bridge, this being considered as the ordinary traffic; and it must also carry 12,500 pounds as congested traffic. The floor beams, moreover, will be dimensioned to meet the stresses of unusually heavy concentrated loads. The loading assumed for the foot walks is a maximum of 100 pounds per square foot.

The accompanying illustrations show the character of the masonry piers. These are of a simple and massive design, well suited to the character of a bridge of these monumental proportions. They are faced with dressed granite, and will harmonize well with the finished steelwork of the trusses.

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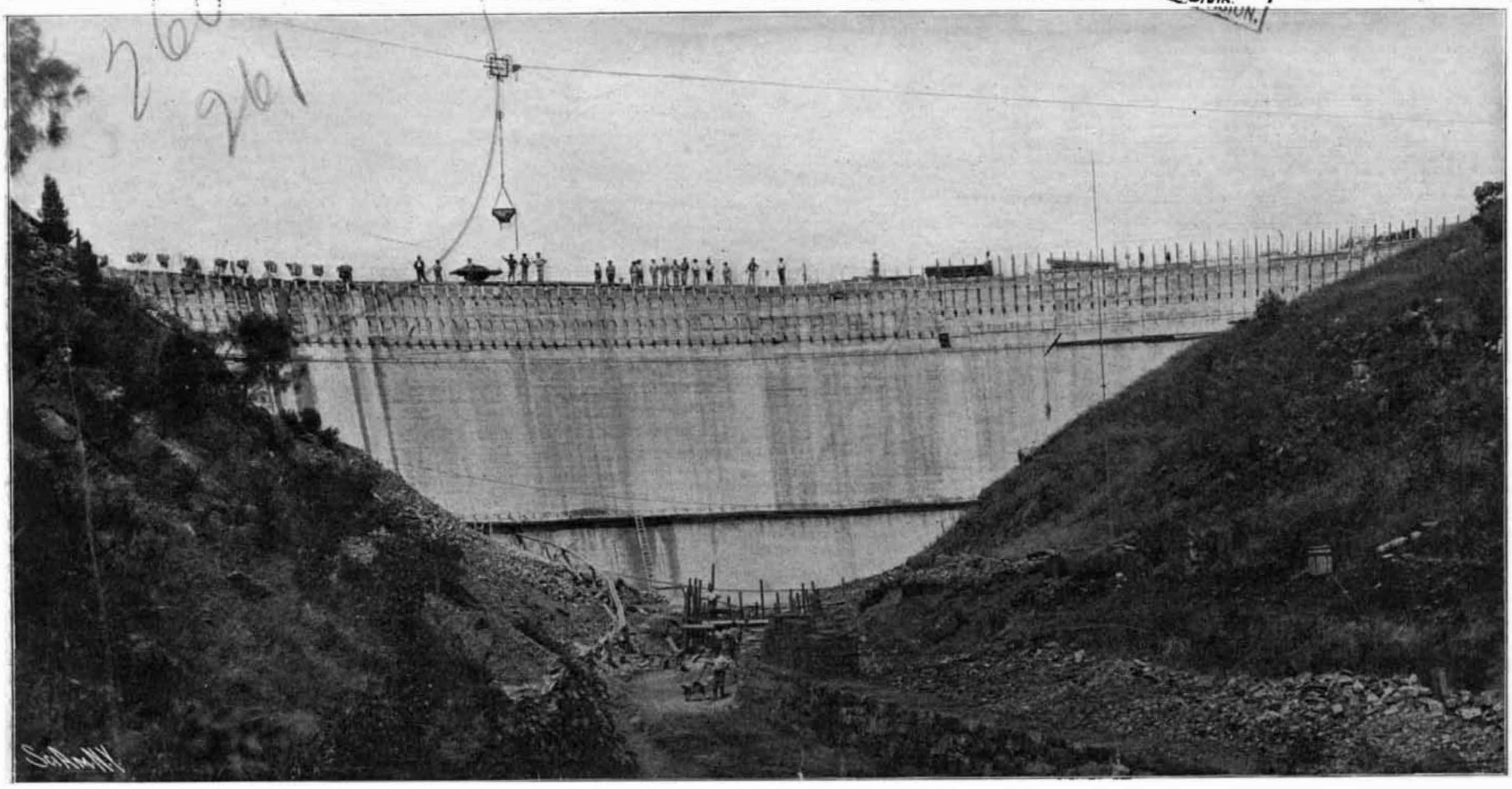
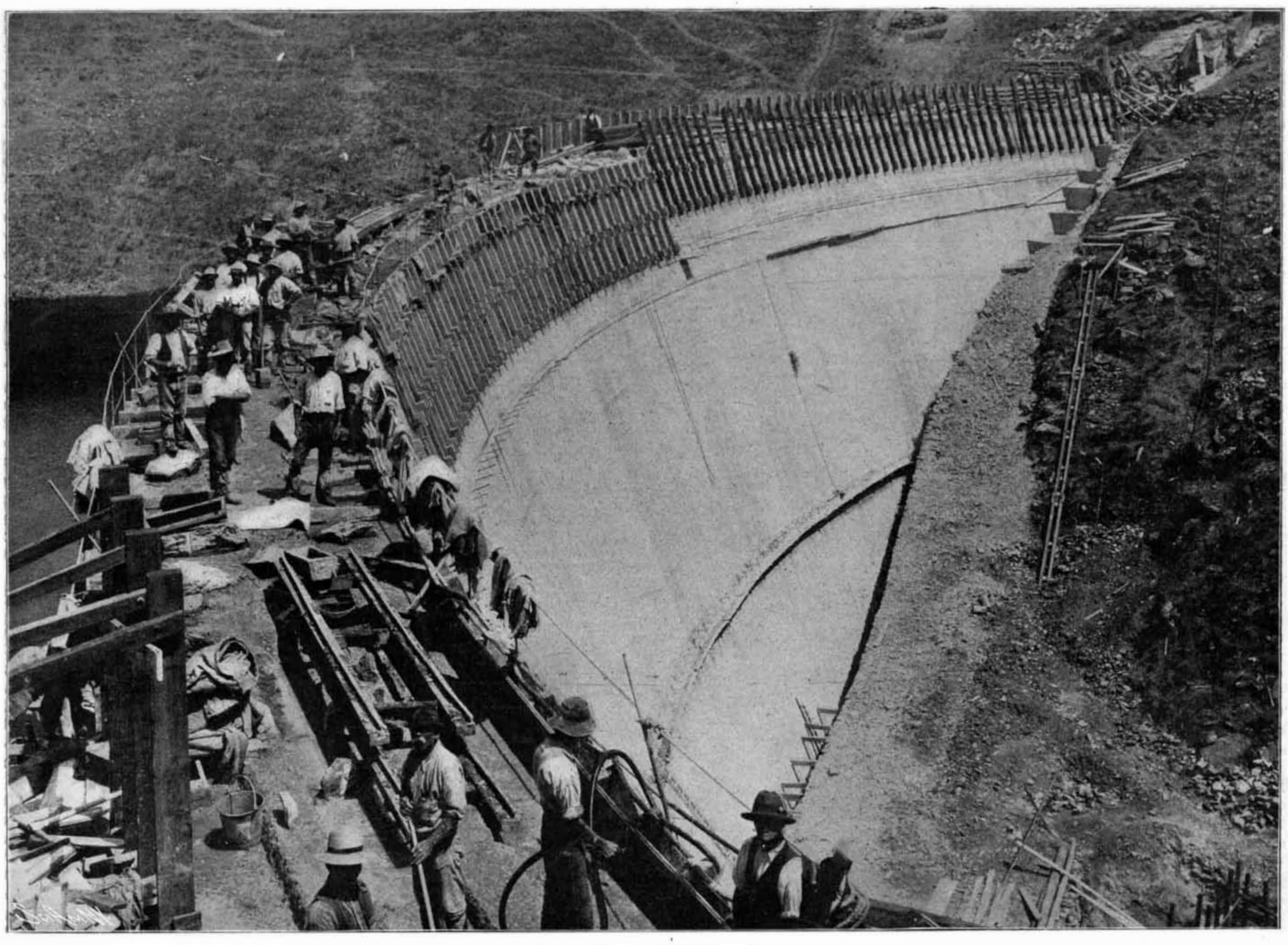


View of the Dam From Down Stream.



The Dam in Course of Construction.

THE CURVED CONCRETE DAM AT BAROSSA, AUSTRALIA.—[See page 266.]