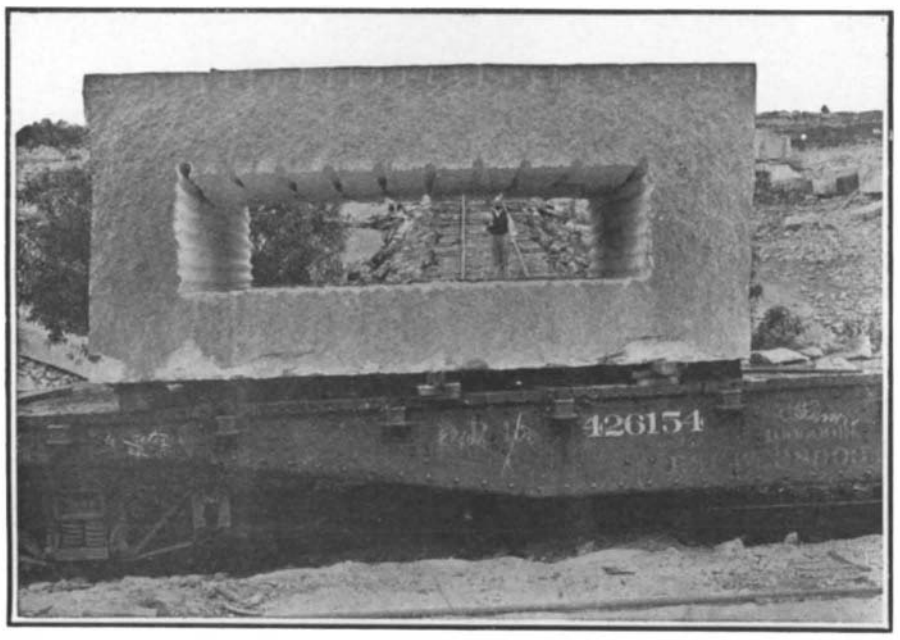
is then put on, and the mantle is clamped between two metal rings by pressing a lever. With this machine one woman can cap, or mount, 2,000 mantles in a day of nine hours.

The mounted mantles then go to the shaping machine, where they are put on forms and brushed by revolving brushes, which stretch them uniformly and press them closely to the forms, while their metallic heads are forced into hoods which compress and tighten them.

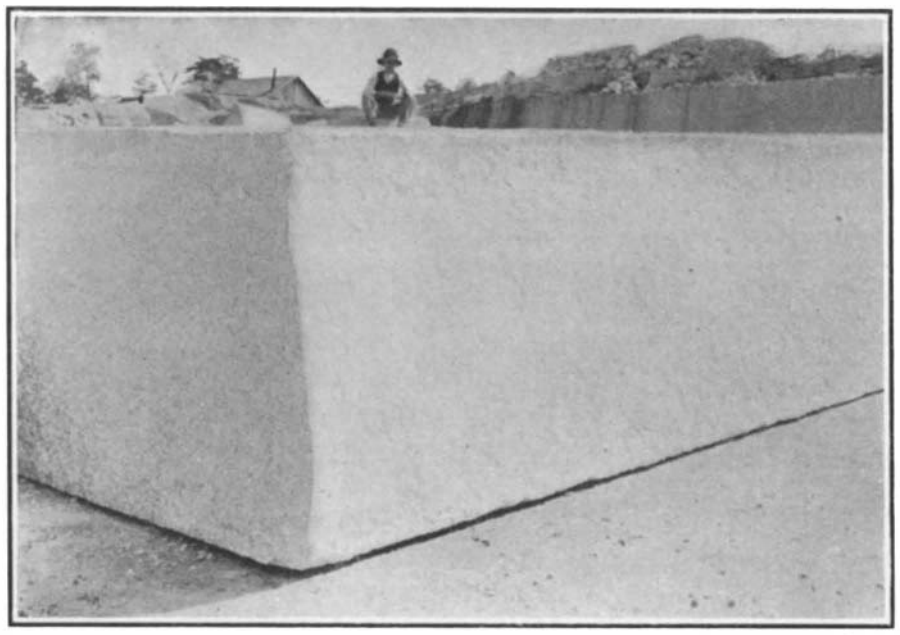
Ten mantles at a time are lifted from the ten forms of the shaping machine by a rod and conveyed to the incinerating room, which, from the technical point of view, is the most interesting and original part of the establishment. By the employment of cams the incinerating machine automatically performs several successive operations. After the fiber of the mantle has been consumed by the first ignition, the head of the mantle is decarbonized, and at the same time reinforced by the application of a flame of compressed gas, which reduces the nitrates of thorium and cerium to oxides. The burning of the interior follows. The burners ascend and descend five times inside the mantles, and give them their final form. The tops of the mantles, which were impregnated with an additional quantity of nitrates in the reinforcing process, are subjected to still another firing. The photograph shows, above the burners, a ventilator, which is lowered before the machine is started, so that it surrounds the burners and carries off all the products of combustion. The ventilator opens the gas cock as it descends and closes it as it rises. In the illustration the ventilators of the machines are raised, in order to show the interior. The entire process of incineration occupies about three minutes, and is applied to 20 mantles simultaneously.

The incinerated mantles are impregnated with collodion, in order to make them less liable to breakage in packing and transportation. This process, also, is effected by a machine, which executes all the necessary movements by means of cams, the mantles being supported by rods carried on endless chains and dipped in a trough of collodion about six feet long. The mantles then go to a drying room heated to about 110 deg. F., through which they are carried on endless chains in a circuitous path. The journey occupies half an hour, and terminates at a clipper which, operated by a woman by means of a crank and a lever, trims the mantles at the bottom to the desired length.

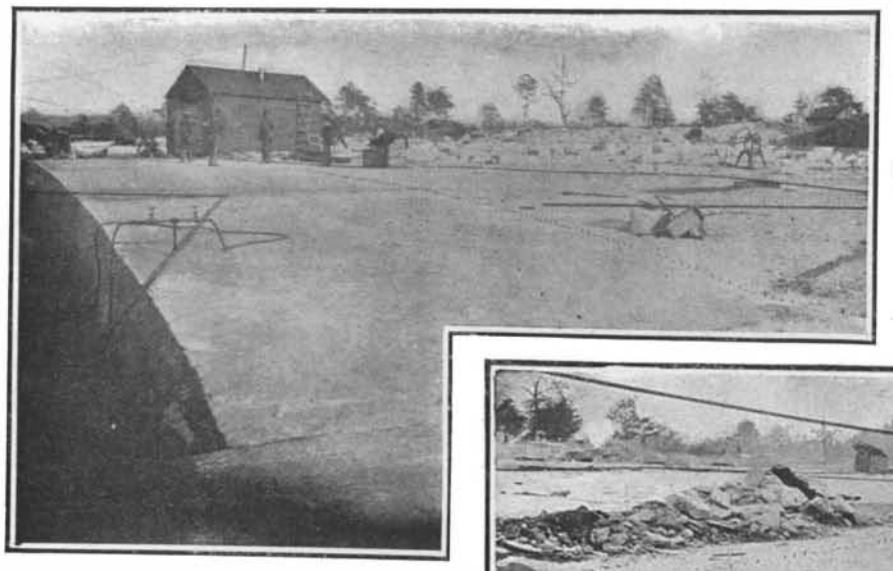
During the entire process of manufacture, the Hella mantles are never touched by the hands of the operatives. Even after they have been trimmed, they are lifted with rods for conveyance to the packing room, where a simple machine suspends each mantle in its carton in such a manner that it is perfectly protected from shocks, and can be shipped with safety to any distance. In use also these mantles appear to be stronger and more durable than those hitherto employed.



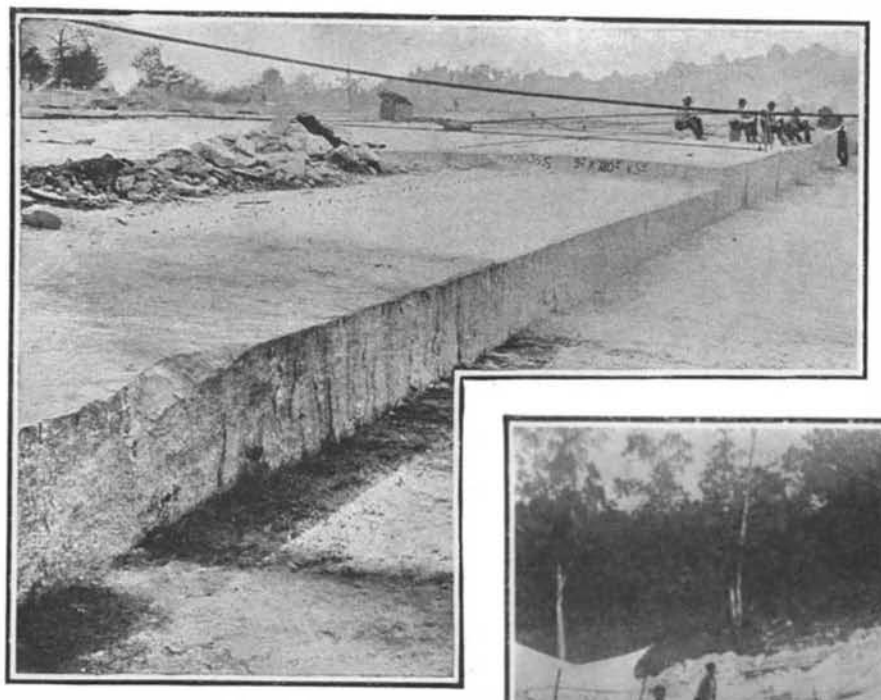
The die for the Washington monument, Brooklyn, in the rough. Weight over 60 tons. Cored out to reduce the weight.



View of an enormous ledge, showing the seam at the bottom made by the "lifting process."



Ordinary ledges of varying thickness.



A common form of ledge.

THE "LIFTING PROCESS" IN THE QUARRYING OF GRANITE

BY L. B. WARD.

Rocky masses in great abundance are to be found in North Carolina, some of its mountains being almost solid rock. The section of country at and around the vicinity of Mt. Airy is composed almost entirely of these rock masses. The Mt. Airy quarries are situated on a hill many acres in area, very gradual in slope and practically bare of vegetation, composed of a solid, homogeneous mass of moderately hard granite, which shows no ledges or bed planes whatever. Near these quarries is Stone Mountain, about 1,000 feet high and four or five miles in circumference, a huge mass of granite similar to the Mt. Airy quarry lands, with the same scant vegetation.

The fact that these masses of stone show no ledges or bed planes whatever, and split readily and in straight lines in any direction, is taken advantage of to create artificial beds to work on. Large laminations or sheets of granite are separated from the mass at a single "lifting" operation, by successive use of powder and compressed air.

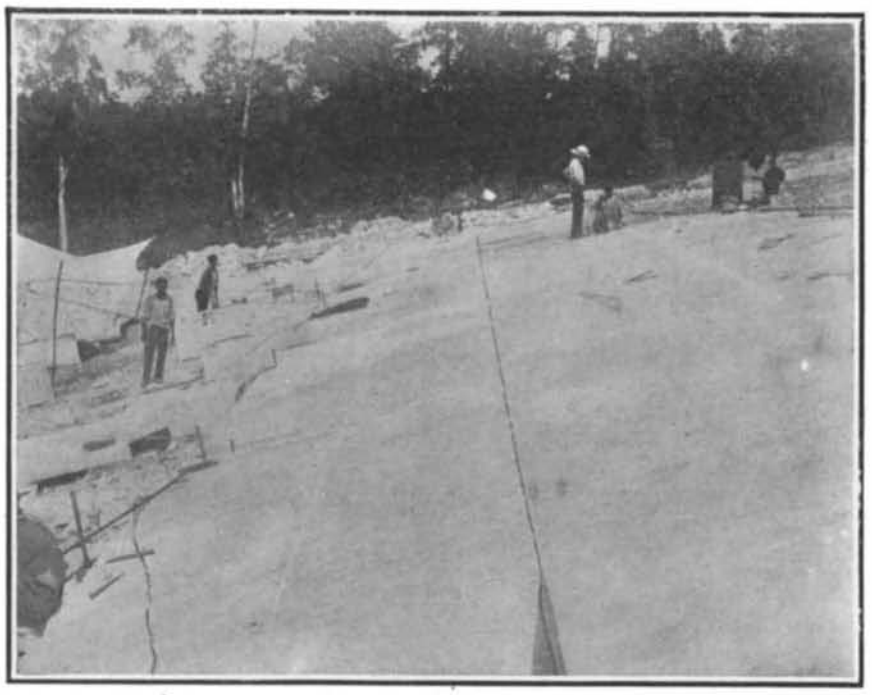
The "lifting process" is causing much interest and attracting attention throughout the world.

This process is applicable to quarries of large horizontal areas and in solid masses, and such conditions being almost ideal at the Mt. Airy quarries, the "lifting process" is altogether used. The tremendous advantage afforded by "lifting" can be readily understood, as by means of a "lift" granite of any desired area and of definite thickness can be made available for surface work and drilling.

The largest stone required for any possible construction could be produced thus; the weight of the larger stones now produced has to be reduced to the capacity of the largest equipment furnished by the railroads, by coring.

At the central power station in the quarries are two huge water-tube boilers, each of 210 horse-power. These supply steam to the air compressor, which has a capacity of 2,000 cubic feet of free air per minute. This air is conducted by six-inch pipe lines running the entire length of the quarries. Lead lines distributing it to all parts of the quarries, make it available at all points for "lifting," as well as for use with pneumatic tools.

In the center of the area to be lifted, a drill hole two or three inches in diameter is sunk six or eight feet in depth (according to the required thickness of the stone). The bottom of the drill hole is enlarged into a pocket by



A "lift" being split and drilled into required widths and lengths.

THE "LIFTING PROCESS" IN THE QUARRYING OF GRANITE.

exploding a half stick of dynamite; a handful of powder is then exploded in the pocket thus formed. This starts a horizontal crack or cleavage across the greater diameter. The charges of powder are now increased in size, and are exploded in the cavity, the drill hole being plugged at every blast to confine the gases and cause constant force upon the stone, until the crack has extended 75 or 100 feet in all directions from the lift hole. A pipe is then cemented into the hole, and connected with the air pipe line of the air compressor by means of a globe valve, and is used gradually to admit compressed air at between 70 and 80 pounds pressure until the crack or cleavage extends until it becomes visible in a thin edge out on the hillside.

Sheets of several acres and of any required thickness can be so "lifted," thus affording a bed plane to which quarrymen can work, drilling and splitting the stone into proper sizes for the purposes required.

It can readily be seen that a great deal of time, labor, and expense are saved by this unique process.

THE HEAVENS IN NOVEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

Morehouse's comet, which at the time of writing is visible with the naked eye, and conspicuous in a field-glass, will continue in sight throughout November, though diminishing somewhat in brightness as it recedes from us. Its apparent path is almost directly southward, through Lyra and Aquila. On October 25 it is close to the star γ Lyræ, on November 7 near ζ Aquilæ, and on November 30 near λ Aquilæ. These three stars are shown on our map, and with their aid it will be easy to find the comet.

At present it shows a nebulous head, without any well-defined nucleus, and a long, nearly straight tail, brighter in comparison with the head than is usually the case. At least this was its telescopic appearance two nights ago. Last night (October 15) the tail was conspicuously distorted and bent. Whether this remarkable change is due to some change in the emission of the fine particles of which the tail is composed, or to interference with their motion after leaving the head, or some such thing as collision with a swarm of meteors, no one can say yet.

It is to be hoped that many photographs of the comet will be obtained at this interesting time, for their study may help us to explain these strange phenomena.

The comet is still approaching the sun, and if it follows the usual behavior of such objects, we may expect that its tail will increase in length and brightness. It will be well worth the careful study of both the amateur and professional astronomer as long as it remains visible in our skies.

By the end of December it will be apparently very near the sun. Indeed, it will very nearly pass behind it about January 1, and after that date it will be visible only in the southern hemisphere, where it will probably be observable for some time.

THE HEAVENS.

The great square of Pegasus, whose acquaintance we made last month, is now almost overhead. Its western side points downward toward the bright star Fomalhaut, far below, near the southern horizon. On the way we pass by Aquarius, west of which is Capricornus, with its pretty double star α. The eastern side of the square, carried down, but not so far, points out the planet Saturn, which is in Pisces only a few degrees from the vernal equinox, the point from which the right ascensions of all the stars in the sky are measured.

Below Saturn, about as far again, in the same line, is an isolated star of the second magnitude, β Ceti. The rest of the constellation to which it belongs may be identified upon the map. The variable Mira has now passed maximum, but is still visible to the naked eye, though fading steadily. In the east the forerunners of the winter constellations are in sight. Taurus is pretty well up. The cluster of the Pleiades, and the more extensive group of the Hyades, which includes the bright star Aldebaran and the V-shaped group near it, once identified, cannot be mistaken.

To the left of Taurus is Auriga, with the very bright yellow star Capella. Below these Orion and Gemini are rising, and above them are Perseus and Aries. Andromeda is still higher, and the great nebula (shown on the map) is almost exactly overhead—not the most convenient place for observation, though theoretically the best.

Cassiopeia and Cepheus are between the pole and the zenith. Ursa Minor and Draco are below the pole on the left, and the Great Dipper lies close along the northern horizon.

In the west Cygnus is high up, with Lyra below it, and Hercules setting in the northwest. Farther south is Aquila, with the small groups of Delphinus and Sagitta above it. This is at present the most interesting region of the sky, for it is here that we may look for the comet—as already described.

THE PLANETS.

Mercury is morning star in Virgo and is well placed for observation around the time of his greatest elongation on the 13th. At this time he rises about 5 A. M. and is well clear of the horizon before dawn. The bright star Spica is about 10 deg. west of the planet, and rises forty minutes earlier; but Mercury is much the brighter of the two, and may be distinguished by this, as well as by his position.

Venus is also a morning star, and in Virgo, but rises earlier, not far from 3:30 A. M. She is now more than 100 million miles from the earth, but is still brighter than anything else in the sky.

Mars is likewise a morning star and is not far from Venus. She is moving eastward faster than he, and on the 30th she overtakes him, and passes north of him, distant little more than one degree.

Jupiter is in the morning sky too, but rises earlier than the others—about 1 A. M. in the middle of the month.

Saturn alone of the conspicuous planets appears in the evening sky. He is in Aquarius, and comes to the meridian about 9:30 P. M. on the 1st and 7:30 on the 30th.

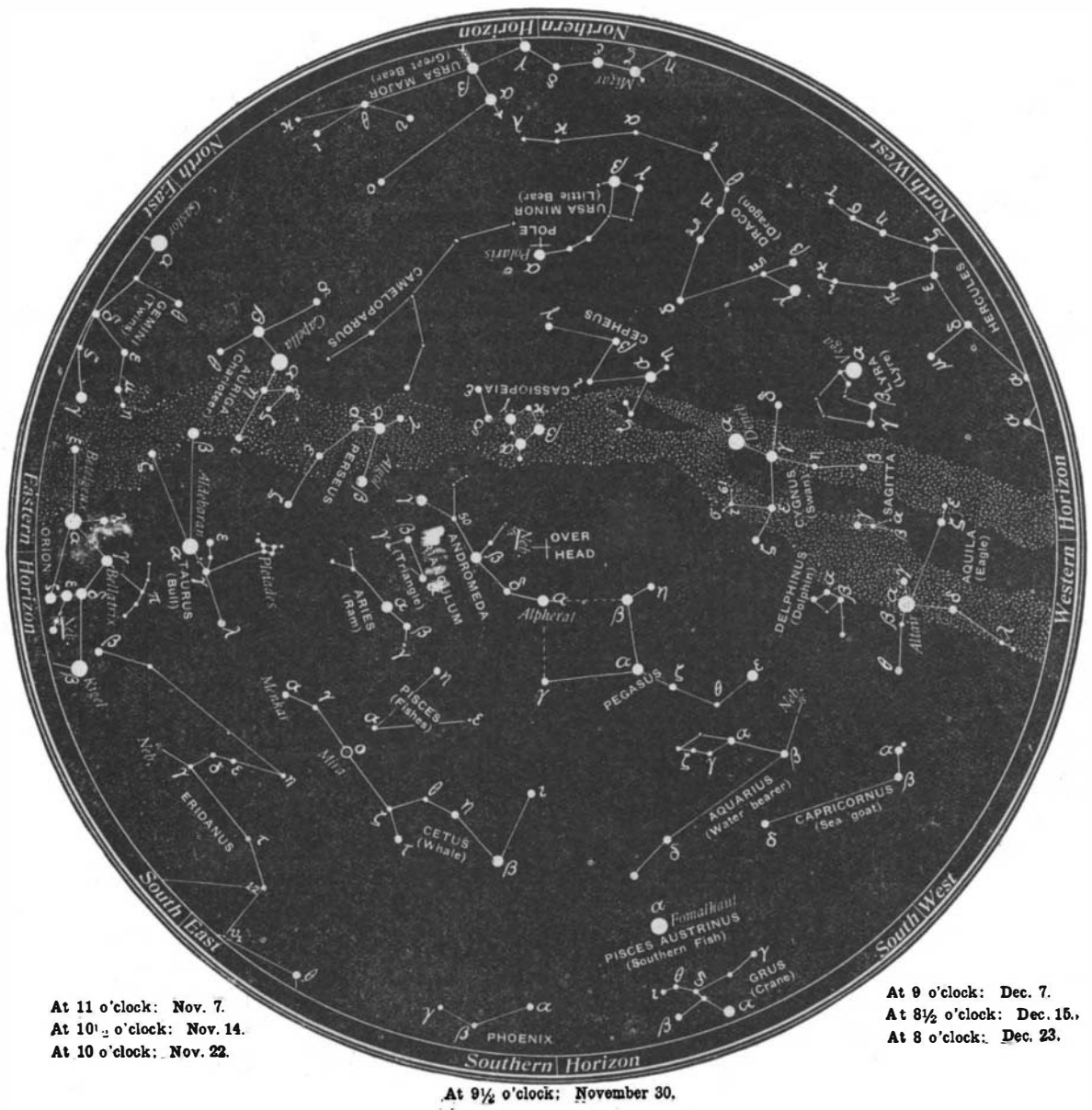
Uranus is in Sagittarius, too far south and too near the sun to be observed, though technically he would be called an "evening star." Neptune, which is in Gemini, comes to the meridian about 3 A. M. and may be observed in the morning.

THE MOON.

First quarter occurs at 9 A. M. on the 1st, full moon at 3 A. M. on the 8th, last quarter at 7 P. M. on the 15th, new moon at 5 P. M. on the 23d, and first quarter again at 5 P. M. on the 30th. The moon is nearest us on the 4th and farthest off on the 16th. She is in conjunction with Saturn on the 4th, Neptune on the 12th, Jupiter on the 17th, Venus and Mars on the 20th, Mercury on the 22d, and Uranus on the 26th.

It may be added that the Leonid meteor shower is due as usual on the mornings of November 15 or thereabout. But there is no reason to expect much of a display this year, so it will not be worth sitting up to see.

Princeton University Observatory.



At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9½ o'clock: November 30.

NIGHT SKY: OCTOBER AND NOVEMBER

THE YUMA IRRIGATION DAM.

BY DAY ALLEN WILLEY.

Within the next year, one of the most notable projects connected with the reclamation of arid lands in the Southwest will probably be entirely completed. While the work includes the storage of water on a large scale, and its distribution by means of irrigating canals, the extraordinary difficulties encountered by the engineers in building the necessary dam and in restraining the rivers in the vicinity, have made the undertaking unique among the irrigation enterprises.

In a recent issue, a feature of the Yuma project as it is termed was described in the extensive levee work required to confine the channels of the Gila and the Colorado rivers during high water, to prevent the reservoirs and canals from overflowing during floods, also to check the movement of sediment carried in such enormous quantities when the streams are at high-water mark. The formation of the embankments by means of abatis made from young trees and brushwood holding the earth embankments, also the jetty system for retarding the flow of the water, were detailed and illustrated. Another problem necessary to be solved, however, was how to create a permanent reservoir of sufficient size for irrigation purposes, strong enough to resist flood action, and so constructed that it would not be shallowed or filled with the sediment. The great variation of the volume of water in the Colorado and the depth of the mud and other detritus on its bottom above rock strata added to the difficulty. A dam across the river was essential, but the question was how to build it so that it would not be washed out, or at least partly demolished. Could it be erected on a solid foundation, and could its ends be securely anchored in the formation on either side?

Preliminary surveys for the general project were made early in 1904. Several different locations were also examined to determine the best place for this structure, and a search was made for bedrock with diamond-core drilling machinery, at all possible dam sites between Yuma and Picacho. As a result of these explorations, the Laguna weir site was selected as the most desirable one for the construction of a weir to serve the lands near Yuma, a high dam and high-line canal being considered impossible. The type of weir selected is one that has been tried during the last fifty years at numerous places in India and Egypt under similar conditions, three dams having been constructed on the Nile River within the past fifteen years, on practically this same plan, all having served their purpose efficiently and being in operation today. This type of weir consists of a loose rock structure with a paving of stones 1½ feet in thickness on the downstream slope, the structure being tied together with three parallel walls of steel and concrete run longitudinally between the granite abutments on the two sides of the river, the entire structure being further made secure by an apron of loose rock pitching 10 feet in thickness and 50 feet in width at the lower toe of the dam below the sloping pavement. The