HYDRAULIC SUCTION DREDGE ON THE MISSISSIPPI.

BY DAY ALLEN WILLEY.

The hydraulic suction dredge in use on inland waters of the United States has been employed extensively only within the last ten years; but such has been its development, that a revolution in the methods of deepening river channels has resulted from its service. The construction of what engineers term the "Greek letter" series of dredges marked the beginning of a new era in controlling the channel of the Mississippi, and undoubtedly the work done by this type of excavating machinery is responsible for the dimensions of the present boat channel.

The problem presented to the United States engineers by the Mississippi River has been one of the incentives which has led to the designing of the modern suction machine, not only for inland waters, but for the excavating of deep-sea channels such as the entrance to New York harbor. The "Alpha," "Beta," and other dredges of this type, constructed for the Mississippi service, have a number of points in common with the excavators which are employed upon the New York improvement, but were designed for use in comparatively shallow water, and to remove a wide area of the bottom of the river.

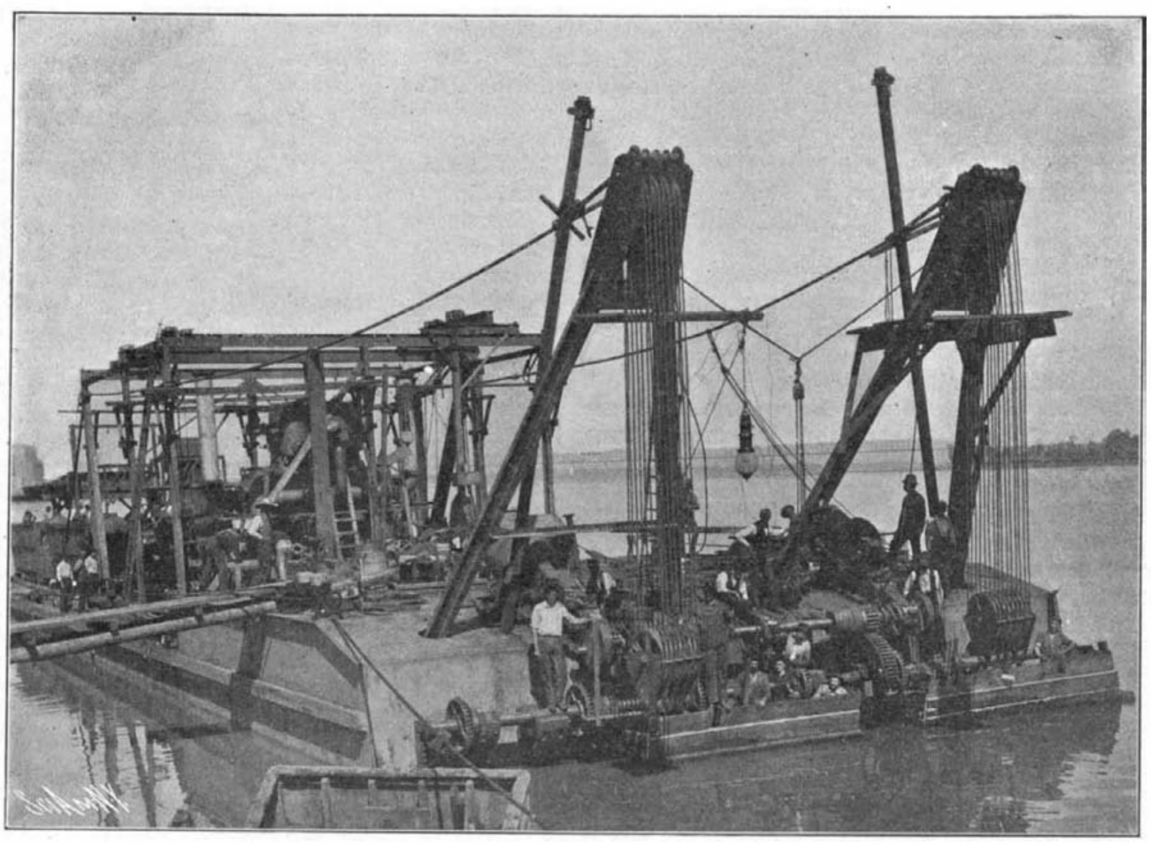
The accompanying illustrations give an excellent idea of the arrangement of the pumping and other machinery on the Mississippi dredges, being photographs taken at the time the mechanism was installed on the "Beta," one of the largest of the Greek letter series. At the time it went into commission the "Beta" was by far the most powerful suction excavator employed anywhere on inland waters, and for several years had the greatest capacity of any of the Mississippi suction machines. The dredge really consisted of two inclosed in one hull, each being provided with its individual pump, conduits, and other connections, so that one section of the dredge could be operated independently of the other. The hull, which was built of steel, was 172 feet in length, 40 feet in width, having a depth varying from 7 1-6 to 10 5-6 feet. The apparatus, which was constructed by the Maryland Steel Company, at Sparrow's Point, and placed in the hull at Cairo, Ill., includes two triple-expansion pumping engines having cylinders of 20½, 33, and 38 inches respectively with a 24-inch stroke, the engines being provided with jet condensers. The pumps are located amidships, each having a runner of seven feet diameter with a shaft of ten inches diameter. The discharge is of the enormous size of 33 inches, and the suction 33¾ inches in diameter. Each suction pipe is provided with three heads of 19½ inches in diameter, making the combined diameter of the suction heads nearly five feet. At the ends of the suction pipes are placed cylindrical cutters five feet in diameter, which have a speed of 25 revolutions a minute, being operated by a separate engine placed on the bow of the dredge.

The pumps, which are driven at the rate of 125 to 130 revolutions per minute, discharge the material through a steel conduit ranging from 1,000 to 1,200 feet in length, according to the location of the dump from the vessel. This conduit is made in 50-foot sections, with flexible connections of rubber hose. It is supported on a series of steel pontoons, and is extended forward on the craft, and is usually placed up-stream from the dredge, advantage being taken of the current in controlling the movements of the latter when in service. The upper portion of the suction apparatus is also buoyed on a pontoon attached to the bow, in order to partly relieve the strain caused by the weight of the pipes when carrying material. The suction conduits are raised and lowered by arms projecting obliquely from the hull, each arm supporting a block through which are passed cables attached to each conduit. By this method the suction apparatus can be immediately lifted from the water, when it is necessary to change the position of the dredge or to perform some other service.

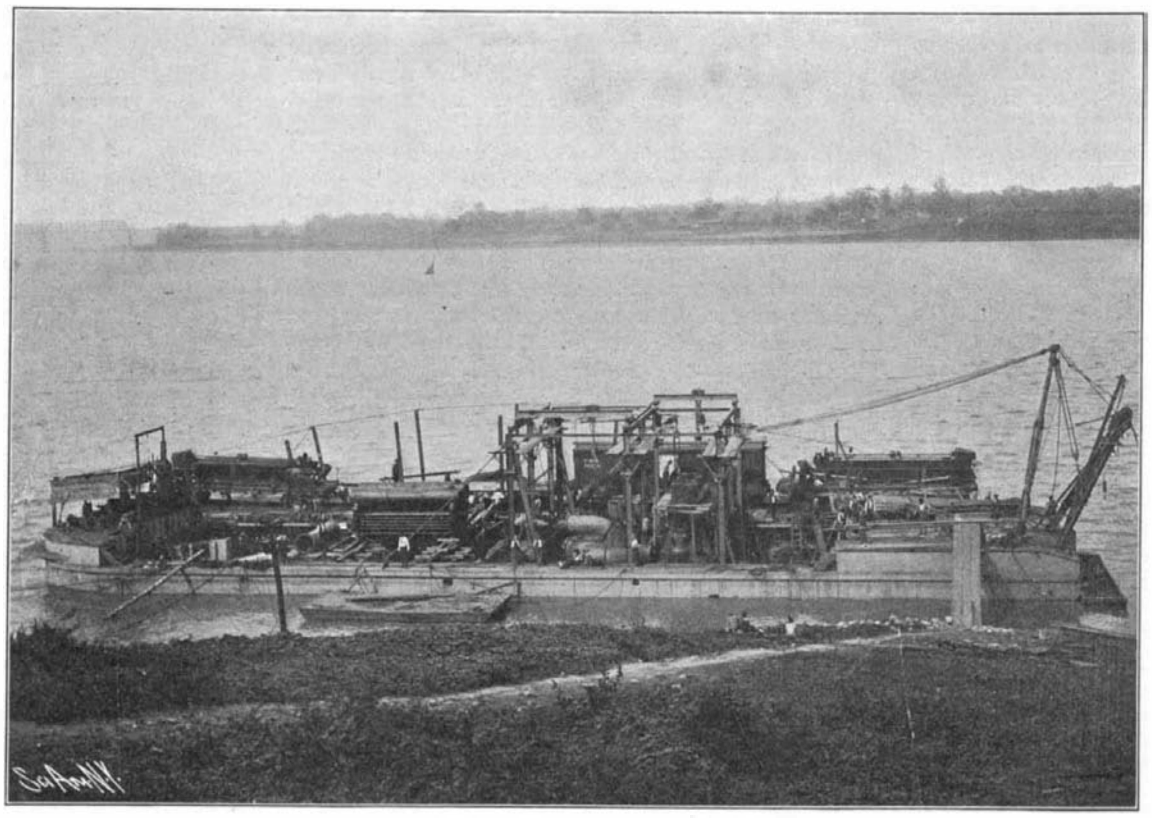
Steam is generated on the "Beta" by a battery of four boilers, each representing nominally 375 horse-power. Steam is not only employed for driving the pumps, but for operating an electric-light plant for working at night and for several other auxiliary purposes. When in operation the dredge is held in position by two vertical spuds set astern, which are controlled by a three-drum hoisting engine.

Considering the dimensions of the suction and discharge pipes, and the high power of the pumping engines, it was expected that the dredge would be capable of removing a much greater quantity of material than any other type of river excavator that has yet been employed in this country. But a test of the service showed that the capacity had been underestimated rather than overestimated; for on ordinary work the "Beta" has removed 5,000 cubic yards of sand in a single hour, discharging it at a distance of at least 1,000 feet from the excavation. While many of the shoals on the Mississippi consist principally of sand, at times clay and formations are encountered so hard that the use of the cutter is necessary. It has been found with this attachment, however, that a dredge of the "Beta" type can work on practically any portion of the stream, except where snags or some other unusual obstacle exists.

One of these suction dredges and its auxiliary craft represent a small fleet of boats. The "Beta" usually requires two towboats to move it from shoal to shoal, as well as a pile driver, two river barges for carrying the discharge pipe and other material, as well as a barge which has been fitted up for a combined blacksmith and machine shop. To operate the dredge proper and the discharge pipe requires a crew of about sixty men; but estimates made of the cost of excavation by this method compared with other plans which have been employed upon the Mississippi, show that it is far more economical, owing to the much larger quantity of material which can be removed in a given time.



Detail View of Bow Section of Dredge, Showing Elevators for Raising and Lowering the Pipe.



General View of the Dredge Machinery.

HYDRAULIC SUCTION DREDGE ON THE MISSISSIPPI.

THE NEW SOLAR OBSERVATORY AT MOUNT WILSON.

BY M. BENEDICT MAYE.

In 1903 Dr. Hale went up to Mount Wilson, and began his new solar observatory. The following spring an expedition for solar research was organized under the joint auspices of the University of Chicago and the Carnegie Institution for the Promotion of Science with the understanding that the Carnegie Institution furnish the funds for the construction of piers and buildings and other expenses incidental to the work, while the University of Chicago furnished equipment and paid the salaries of some of the members of the party.

The Carnegie Institution has granted the sum of $150,000 for use during 1905, which will cover about one-half the cost of the first equipment, with the understanding that should the Carnegie Institution decide to establish a solar observatory of its own, this should take the place of the Mount Wilson station of the Yerkes Observatory and the work be continued under the sole auspices of the Carnegie Institution.

Dr. Hale, who is now president of the Society for International Co-operation in Solar Research, which numbers its members from every civilized country on the globe, has already outlined the plan of research and determined the equipment of two other observatories, the Kenwood—subsequently merged with the Yerkes—and the Yerkes Observatory of Chicago, and he regards the instrument shop of great importance, since it renders possible the construction and frequent improvement of instruments of new type and special design. The operation of the shop is not confined to the construction of the mechanical parts of the instruments; provision is also made for optical work on a large scale.

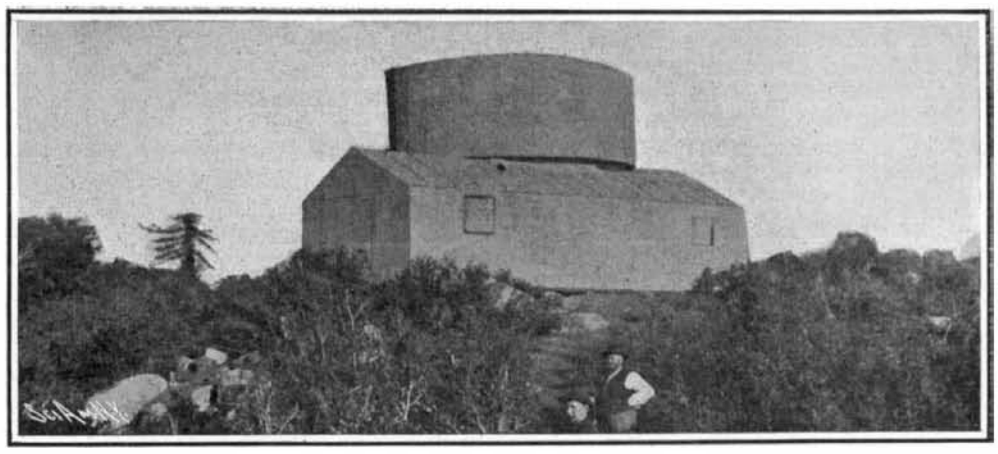
This shop is located at Pasadena, and is 50 by 100 feet, with an optical testing room 150 feet long extending 68 feet beyond it in the rear. It is fireproof, as the optical and mechanical parts of the instruments under construction are very valuable. It contains offices and drafting rooms, machine shop, instrument shop, pattern shop, lacquer room, constant temperature room, room for 5-foot grinding machine, room for 40-inch grinding machine, long optical testing room, photographic dark rooms, enlarging rooms, etc. The equipment includes milling machines, planes, lathes, grinding machines, drill presses, various saws, trimmers, and all other tools needed. The optical laboratory will contain all necessary machinery for grinding, polishing, and testing mirrors with apertures as great as 5 feet and focal lengths as great as 150 feet. Some of the delicate machines are marvels of ingenuity and are the inventions of the director and superintendent. This machine shop at Pasadena saves the hauling of much raw material up the mountain, but a shop at hand is necessary for immediate repairs of instruments already installed, so a building 15 by 35 feet is equipped as small power house and repair shop with 15-horsepower Witte gasoline engine, dynamo, etc., located on the mountain near the laboratory.

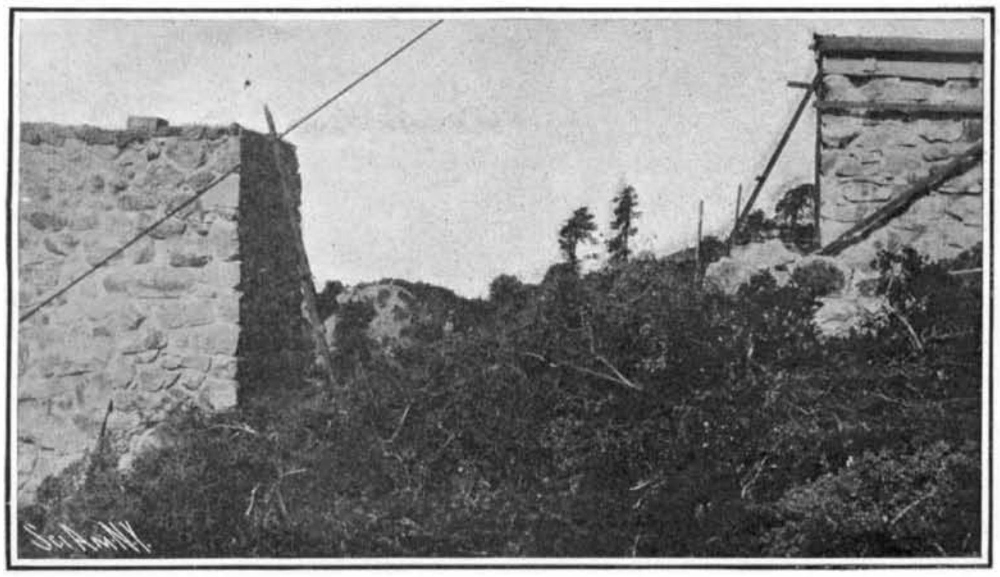
Stone is found on the mountain, but all other building material and all supplies and instruments have been carried up the narrow winding trail on the backs of donkeys, with the exception of the equatorial head of the instrument, weighing about 400 pounds, which was carried up by a specially improvised truck with narrow body and rubber-tired wheels. A sort of one-mule "automobile" has since been constructed from this to meet the requirements of the narrow trails and the character of the loads to be conveyed.

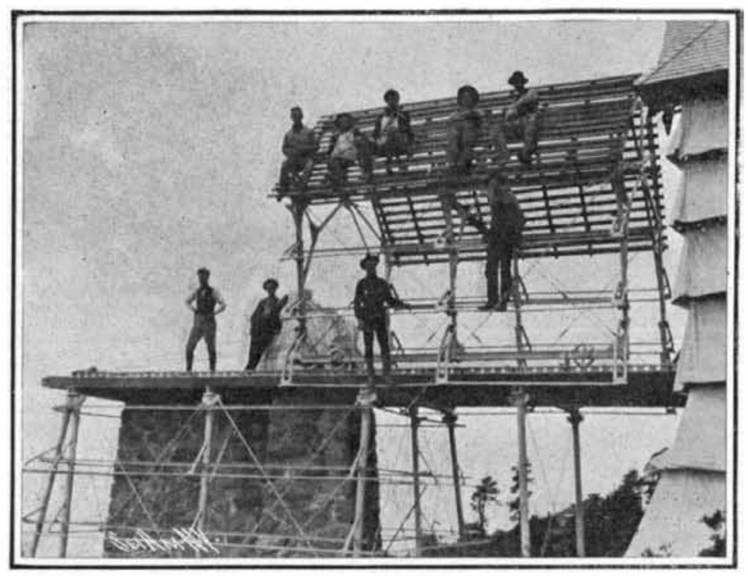
To date over 175 tons have been carried up the mountains by the donkeys, and daily the loaded pack trains make trips, each donkey well loaded, and wearing a cage somewhat resembling a baseball mask to prevent him feeding by the wayside. Half a dozen or more are sent up the winding trails with a driver on horseback to guide them and keep them moving. The leader wears a bell, the tinkle of which warns others coming down on the trail, as it is so narrow there is room to pass only at certain points.

The electricians are just completing the wiring of the buildings of the observatory. It has been a work of half a year for nearly a dozen skilled electricians and many hundred feet of wiring as well as many dynamos have been set up. It is all expert work, often requiring very delicate manipulation.

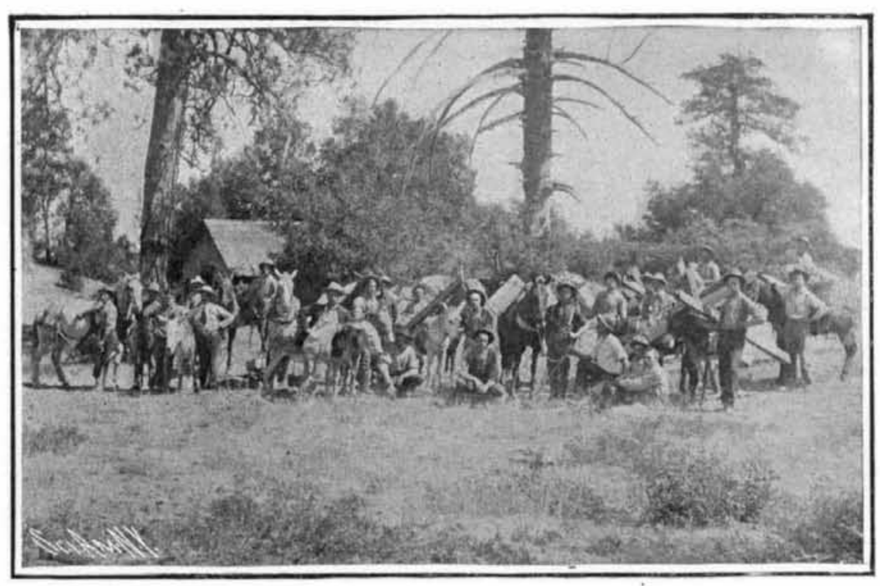

Front of the Snow Horizontal Telescope.

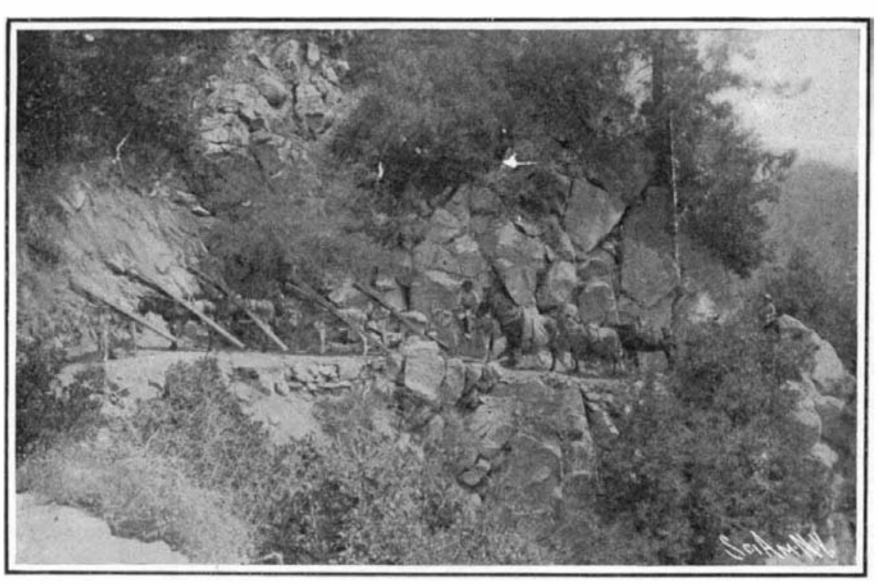

The Original Observatory on Mount Wilson.

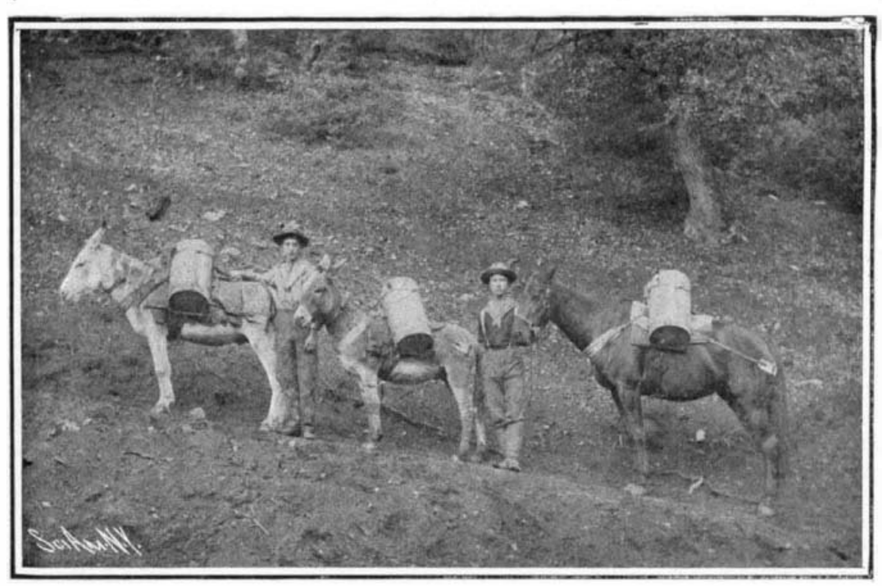

The Two Piers of the Snow Telescope.


Head of Snow Horizontal Telescope in Course of Construction.


How Heavy Parts of the Instruments Were Carried up the Trail.


A Group of Skilled Workmen Employed in Building the Observatory.


Pack Train of Lumber and Cement for Constructing the Solar Observatory.


Packing Water for Mortar to be Used in Building the Observatory.

THE NEW SOLAR OBSERVATORY AT MOUNT WILSON.

The foundations of the new laboratory are well under way, and the building is going up rapidly. It will be located just below the large Snow telescope, between that and the machine shop, and will be well equipped.

The Snow horizontal telescope with its multitudinous attachments is installed in a building 200 feet in length, especially designed to maintain an even temperature with reduced heating and radiation. The walls, supported by a steel framework, are composed of canvas which has been covered with fireproof paint, and are made in horizontal sections overlapping each other, so that a current of air goes through the opening between, yet do not admit light or rain. This gives them the appearance of scales, and the long, narrow structure with its lofty headpiece presents to the wondering tourist something of the appearance of a Chinese dragon spread out on the top of the mountains among the trees. The peak on which it rests slopes abruptly down on all sides, and large trees grow near, so that it is difficult to get a photograph of the building entire.

The Snow horizontal telescope is a cœlostat reflector, about 16 inches in diameter, showing wonderful detail. The great Yerkes telescope with a 40-foot object glass and a 64-foot focus produces an image of but 7 inches in diameter; thus the great advantage of this Snow telescope with its 145-foot focus and 16-inch image of the sun is at once apparent.

The spectroheliograph is 7 inches aperture and 30 feet focal length. The dispersive of this instrument consists of three prisms of 45 deg. retracting angle used in conjunction with a plane mirror so as to give a total deviation of 180 deg. The motion of the solar image, of which a zone about 4 inches wide can be photographed with the spectroheliograph, will be produced by rotating the concave mirror about a vertical axis by means of a driving clock.

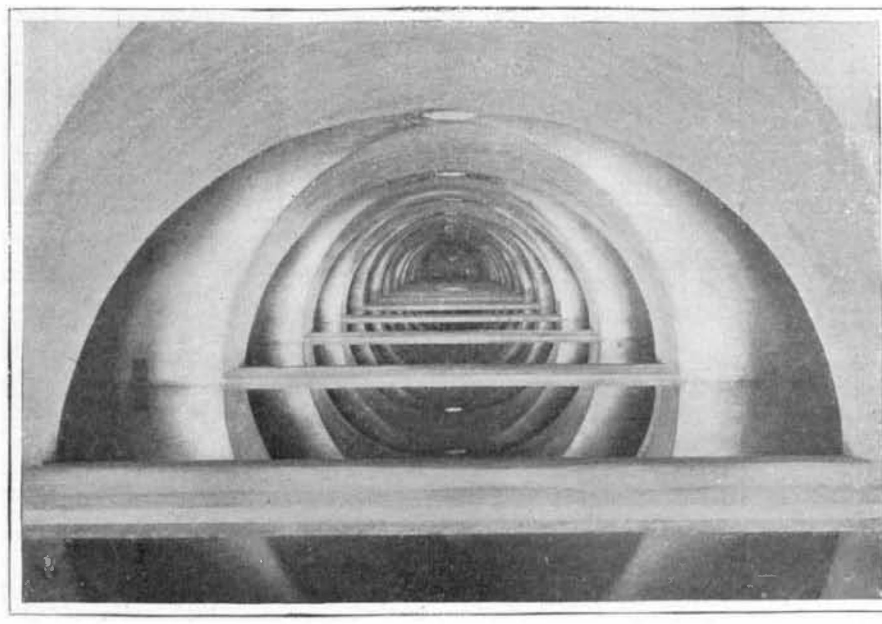
A second driving clock, controlled by electricity so as to be synchronous with the first, will move the photographic plate behind the second slits. Three slits will be provided at the front so as to permit photographs to be taken simultaneously through as many different lines of the spectra.

tographic investigations with the 5-foot reflector should throw light on the past and future condition of the sun. All of the principal researches will thus be made to converge in the problem of stellar development.

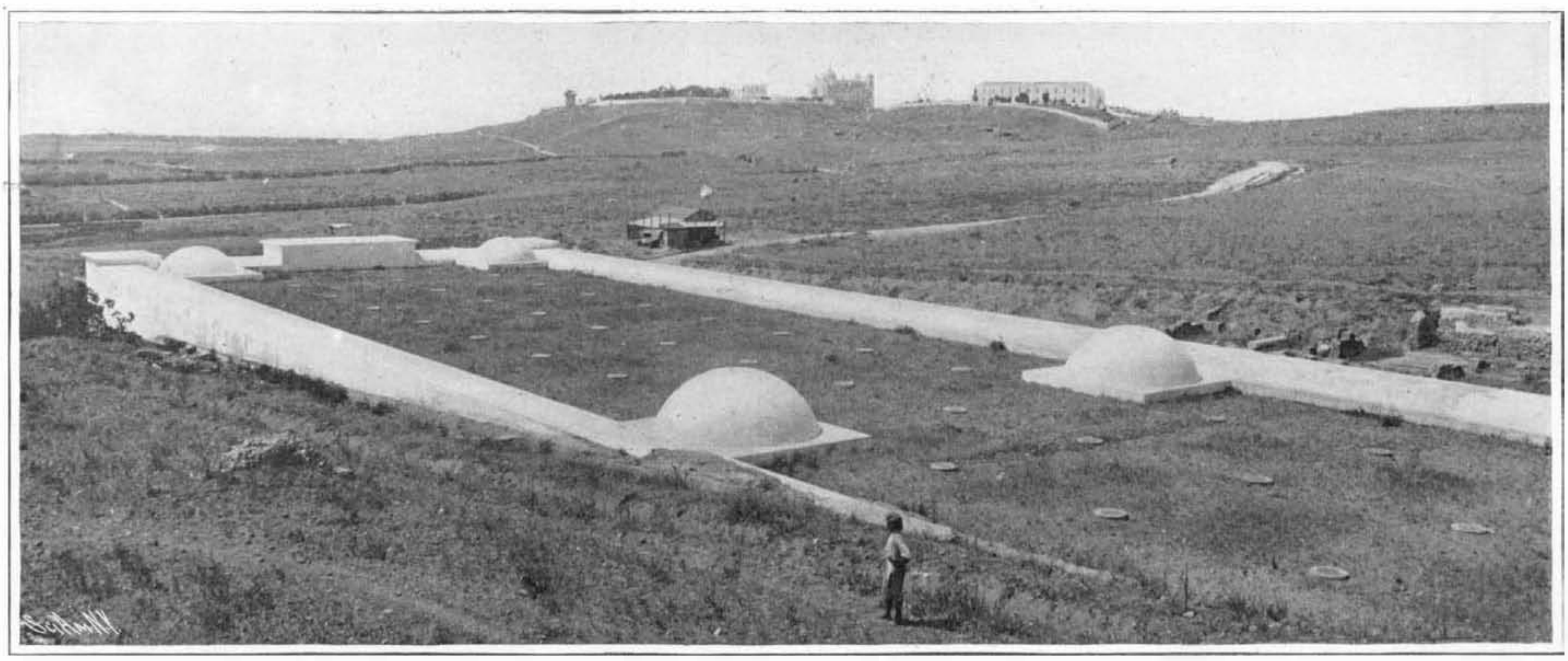
With this new solar observatory for the more complete realization of laboratory conditions in astrophysical research, through the employment of fixed telescopes of the cœlostat type, and the adoption of the Condi mounting for the 5-foot reflector, mirrors of great focal length may be used, providing a large image of the sun for study with spectroscopes and spectroheliographs; also long-focus grating spectroscopes mounted in a fixed position in the constant-temperature laboratory may be used for photographing stellar spectra requiring very long exposures, and radiometers may be used which cannot be employed in conjunction with moving telescopes.

Another object is the development of the spectroheliograph in the various directions suggested by the recent work of the Yerkes Observatory, including the photographing of the entire solar disk with dark lines

Reservoirs of La Malga.



Within the Bordj-Djedid Reservoirs. One of the Chambers Filled with Water.



Reservoir of Bordj-Djedid Restored. Showing Part Which Now Lies Above Ground, the Cupolas and the Openings from Each Cistern. In the Rear is the Height Formerly Occupied by the Citadel of Carthage.

ANCIENT RESERVOIRS AT CARTHAGE.

the cœlostat mirror having a diameter of 30 inches. A second plane mirror 24 inches in diameter reflects the beam from the cœlostat north to either one of two concave mirrors each of 24 inches aperture. One of these concave mirrors, of about 60 feet focal length, is to be used in conjunction with a solar spectrograph of 5 inches aperture and 13 inches focal length. A spectroheliograph of 7 inches aperture resembling the Rumford spectroheliograph of the Yerkes Observatory, and a stellar spectroscope provided with a large concave grating, are mounted in the constant-temperature laboratory.

It is hoped to photograph the spectra of a few of the brightest stars. For fainter ones the spectrograph is to be provided with several prisms for use singly or in combination.

The second concave mirror of the cœlostat reflector is designed to give a large focal image of the sun especially adapted for investigations with a powerful spectroheliograph and for spectroscopic studies of sun-spots and other solar phenomena. The focal length of this mirror is 145 feet, so that it will give a solar image of

Prof. E. E. Barnard, professor of astronomy of the University of Chicago and Yerkes Observatory, who is noted for his many discoveries and beautiful celestial photographs, has charge of the Bruce telescope, which was shipped to Mount Wilson from the Yerkes Observatory last December. It is intended to use the lower latitude of Mount Wilson to reach the regions of the Milky Way which are not attainable from the latitude of the Yerkes Observatory, and to secure photographs of them, and also of some of the great diffused nebulosities which are more or less cut out by the denser air at lower altitudes.

The first object of this new solar observatory is to apply new instruments and methods of research in the study of the physical elements of stellar evolution. Since the sun is a star near enough to the earth to permit its phenomena to be studied in detail, special attention will be devoted to solar physics, and it is hoped that the knowledge of solar phenomena thus gained will assist to explain certain stellar phenomena. Conversely, the knowledge of nebular and stellar conditions to be obtained through spectroscopic and pho-

of hydrogen, iron, and other elements; further application of the methods of photographing sections of flocculi corresponding to different levels; special studies of sun spots, and daily routine records of calcium and hydrogen flocculi and prominences.

A 5-foot equatorial reflector will be constructed with Condi mounting and used in photographing nebulæ, the study of stellar and nebular spectra, and the measurement of the heat radiation of the brighter stars.

In addition to the above, provision will be made for various laboratory investigations necessary in conjunction with solar research. Suitable magnetic apparatus will be installed in order to secure complete record of solar phenomena when storms are in progress.

ANCIENT RESERVOIRS AT CARTHAGE.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Ancient Carthage depended almost entirely upon rain water for its supply, as the aqueduct which brought the water from the mountains at Zaghouan was only built in later times by the Romans. Excavations show us that the streets, the squares, and the