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.

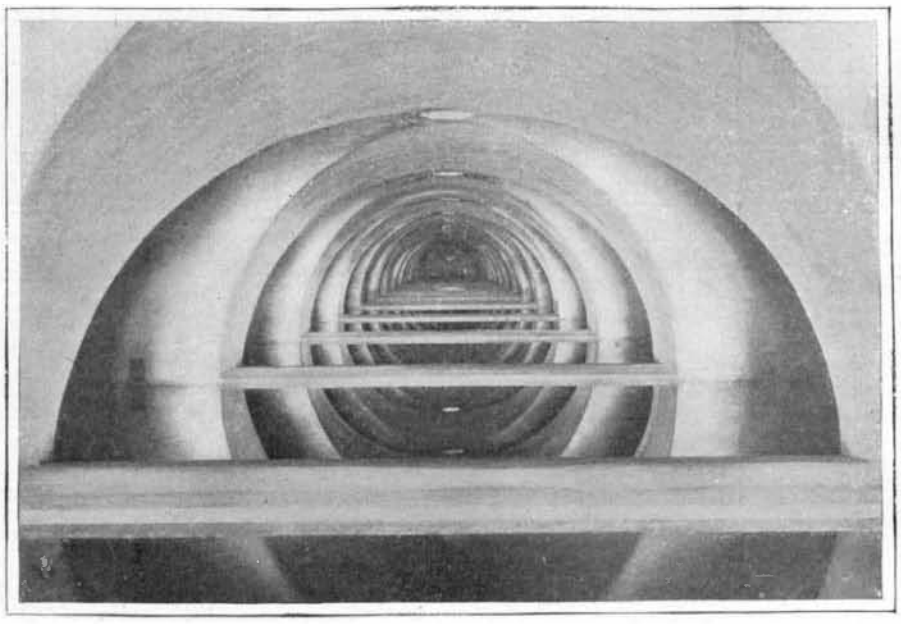
A second driving clock, controlled by electricity so as to be synchronous with the first, will move the photographic plate behind the second slits. Three slits will be provided at the front so as to permit photographs to be taken simultaneously through as many different lines of the spectra.

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.

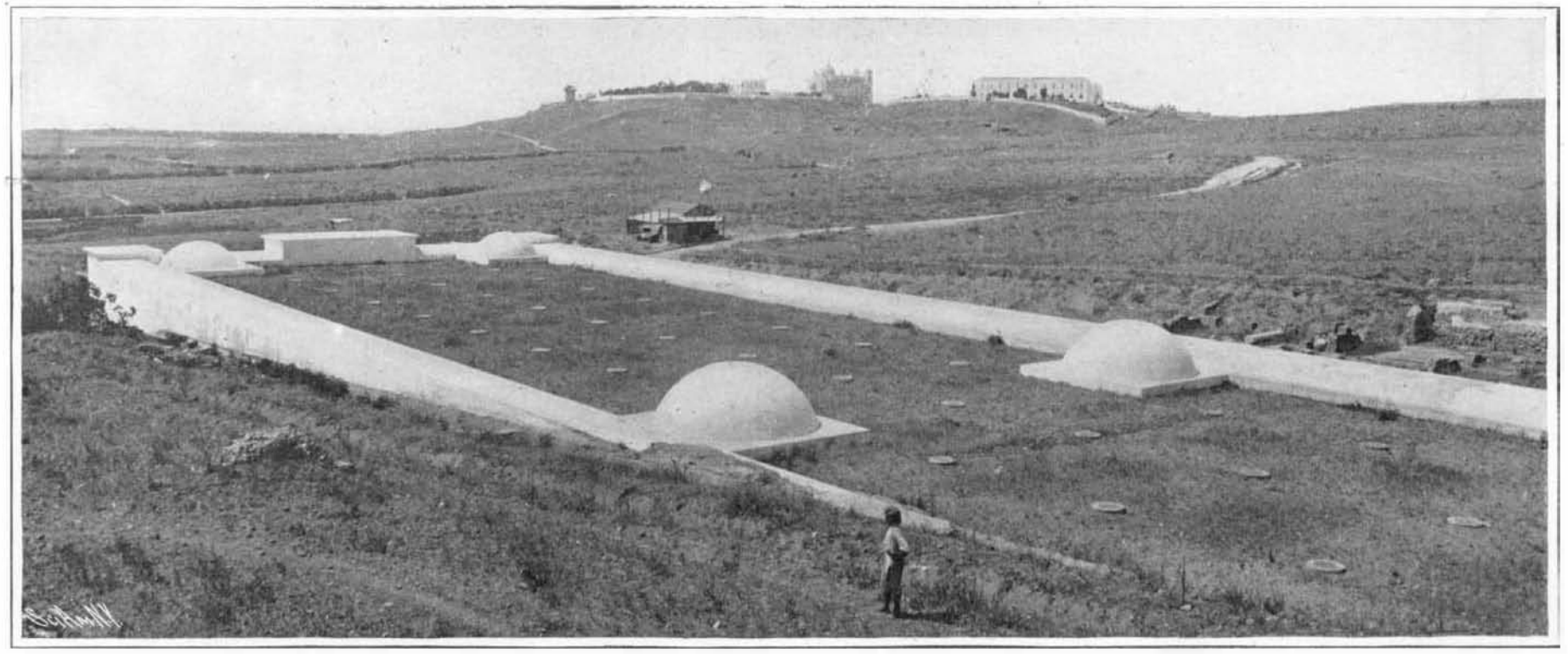
With this new solar observatory for the more complete realization of laboratory conditions in astrophysical research, through the employment of fixed telescopes of the cœlostat type, and the adoption of the Condi mounting for the 5-foot reflector, mirrors of great focal length may be used, providing 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 photographic 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.

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.

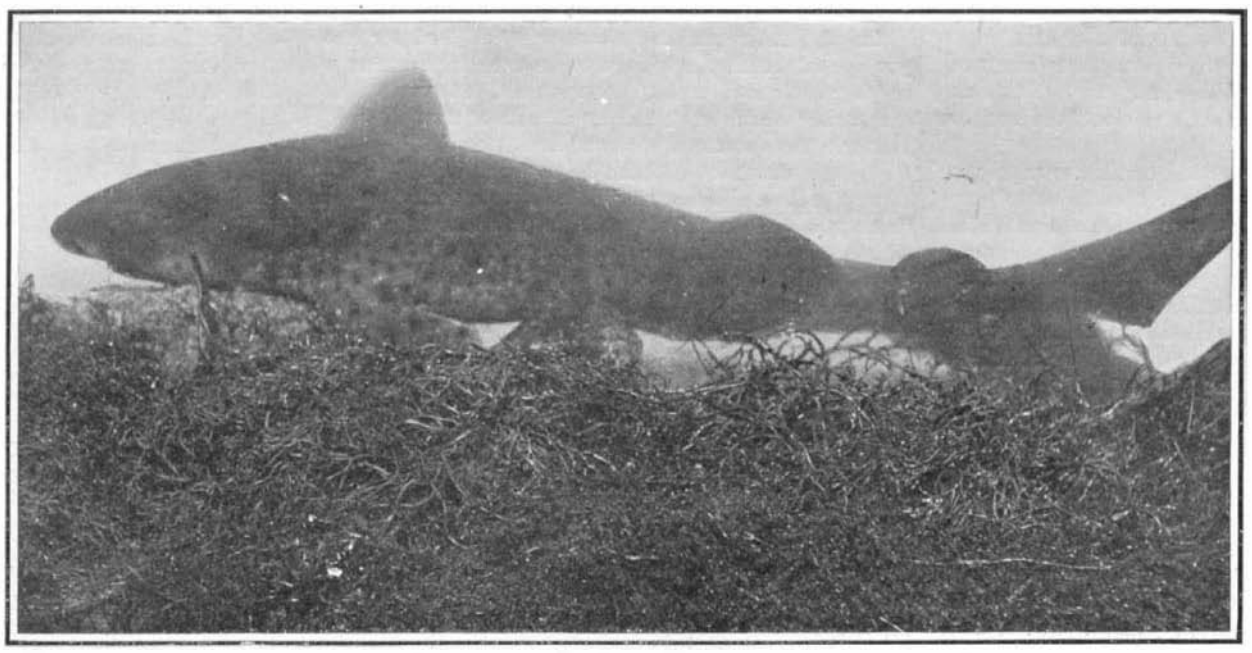
Ancient Carthage depended almost entirely upon rain water for its supply, as the aqueduct which brought the water from the mountains at Zaghouan was only built in later times by the Romans. Excavations show us that the streets, the squares, and the

courts of the houses were paved with large flagstones, and this was done so as not to lose any of the precious fluid. A series of conduits led from the sewers to the immense reservoirs which were placed in the lower part of the city. When we dig down to some depth in the ground we can still find the flagstones in place under the layer of ashes coming from the time when Scipio's soldiers burned down the city.

One of the large reservoirs lies near the shore in the lower part of the city and not far from the old Turkish fort of Bordj-Djedid.

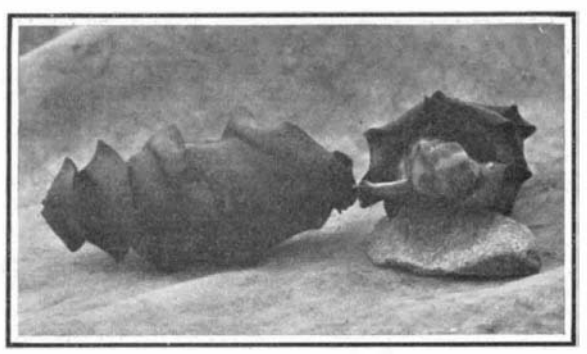
This remarkable construction is formed of eighteen parallel vaulted chambers of considerable length, which lie against each other and are separated by a dividing wall. They are built of masonry and covered with a very hard cement. The great size of the reservoirs may be judged from the fact that the total area covered by the water chambers is 440 feet in length and 125 feet in width, thus forming an oblong structure. Each of the chambers is about 100 feet long and 24 feet wide. The top of the reservoir lies just below the ground level, while the cement floor which forms the bottom is far below ground. Each chamber is covered with a semi-circular vaulting of masonry. From the floor to the top of the vault the height is some 30 feet. The water chambers are rounded off at the ends and they are separated by a strong wall which has a central opening so as to allow the rooms to connect with each other. Along each side of the main construction runs a long and narrow gallery which opens on to the ends of each basin. The floor of the gallery is 20 feet higher than the main floor. It is to be remarked that the two end basins and the middle one of the series have their ends occupied by round chambers in the form of large wells covered by a cupola at the top. These round wells are filled up and there seems to be no doubt that they were used as filters for the water before it passed into the main reservoirs. This fact was virtually proved at the time when the cisterns were restored for use a few years ago. During the work there were found a great number of conduits near the upper part and on all sides. These had been used to bring the water from different quarters into the cisterns. Further down, near the bottom, were seen another set of conduits which led the water off to various parts of the city. Our engraving shows the present appearance of the reservoirs. The main area is outlined by the stone wall which lies above ground, and we also observe the middle and end cupolas which top the filtering wells. The small, circular openings, of which each basin has three, lying flush with the ground, have been covered over with glass. In the background is the historic spot which the citadel of Carthage formerly occupied. It is now crowned by the Cathedral of St. Louis and the museum in which the Rev. P. Delattre is constantly placing new objects which come from the excavations. Another view shows the interior of one of the eighteen long chambers, which is nearly filled with water. The character of the vaulting and the openings in the roof will be noticed. The total volume of water which the whole reservoir contains is estimated at five million gallons.

Another set of great reservoirs is found at some distance from the preceding and nearer the top of the hill. These cisterns were no doubt as extensive as the first series, but they are now in a very dilapidated state and have nearly disappeared under the soil, which has gradually filled them up. When the Arab geographer, Edrisi, visited the spot in the eleventh century he was struck with admiration at the imposing form which they presented.



Swell Shark Photographed While Swimming.

At that time there were twenty-four reservoirs running parallel to each other, each one covered by a vaulting and measuring 330 feet long by 70 feet wide. At present the remains of only eighteen chambers are visible, and these are partially destroyed and filled up with alluvial earth which has sifted in during the ages. Our engraving shows a part of La Malga reservoirs in their present condition. The remains of an aqueduct which supplied the cisterns have been found to the northeast of the Arab village. The natives have found statuettes and other objects around the spot.



Spiral Egg of Port Jackson Shark.

Egg on the right shows the young shark protruding, or as it appears when about to escape.

AN INTERESTING SHARK.

BY CHARLES FREDERICK HOLDER.

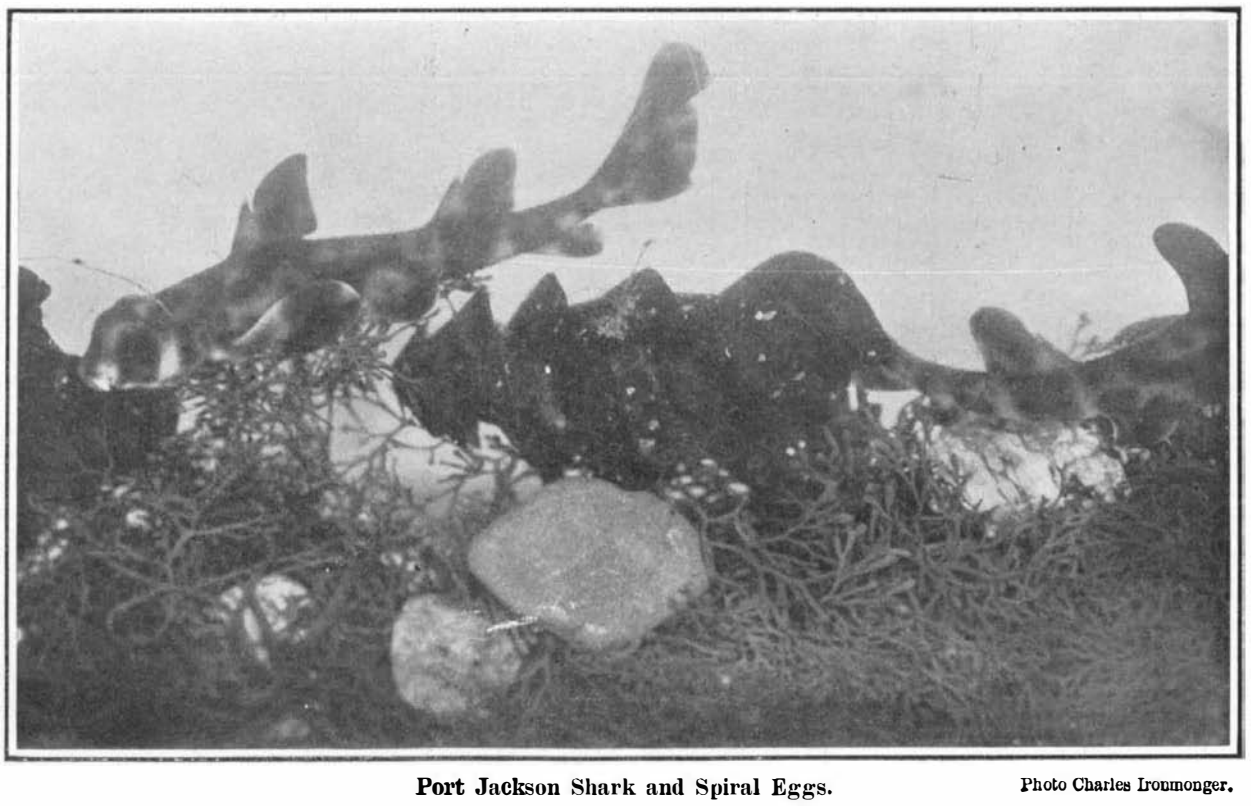
Up to within a few years the ctenoptychius shark was known only by its spines and bits of pavement-like teeth. From these geologists described it years ago, and supposed that like many other forms it had become extinct. As the various zoological expeditions were sent out by different governments one entered Port Jackson, New South Wales, and in dredging found a living Trigonia shell that was supposed to be extinct, as those known occurred only in the fossil secondary deposits in Europe. One of these expeditions found, with the Trigonia shells, spines almost identical with the fossil extinct Cestracionidæ; then a boatman told the zoologist that the fish itself was common there, and volunteered to produce specimens in any quantities.

The Cestraciont sharks are included in the family *Heterodontidæ*, and in the years following four species have been determined in the Pacific Ocean, *Gropleurodus Francisci* and *G. Quoyi* being the best known — the latter from the region of the Galapagos Islands, and the former from Southern California. The modern representatives of these sharks average about two feet in length. They are rendered conspicuous by two dorsal fins, each preceded by a large, powerful, and beautifully colored pink spine—a heritage of the ages. The body is long, tapering gracefully to the tail, which is large, broad, rising upward, with two notches. The shark appears to have a forehead, the head being blunt, and the peculiar nostrils are confluent with the mouth, which is small, narrow, and in the upper lip divided into seven curious lobes. The ridges above the eye are prominent, and the eyes are placed high in the head.

The most interesting feature of the shark is the egg, a somewhat conical-shaped spiral object four or five inches in length, and in form a perfect screw with wide flanges. Its color is a rich, dark mahogany, smooth and beautiful in texture. In the accompanying illustration a group of the young and eggs are shown, the shark being about two months old. The sharks shown were alive and the eggs unhatched. The photograph was taken by Charles Ironmonger under the writer's direction, and a difficult process, the dominating idea being to show the sharks alive but with a perfectly natural environment. The photograph represents a fairly perfect picture of the bottom, algæ, and rocks among which the writer has seen the sharks lying.

One might well wonder what object was attained in the production by Nature of such an egg. It is an almost perfect imitation, as regards color, of some of the weeds in which it is found; and it is very evident that the edges of the "screw" or spiral would prevent it from being washed ashore even in a heavy gale. So doubtless the peculiar shape may be a plan of resourceful Nature to afford protection to the egg, and that it is successful is evident as the shark has with some slight change survived the changes of ages.

I have often taken another shark in lobster pots with the Port Jackson variety, one that bears a close resemblance to it, especially in color and general shape. This is the swell shark, *Catulus uter*. It rarely exceeds two feet and a half in length, and has habits almost identical with the Port Jackson shark, lying in the hollows of the rocks, or hidden away in the dense masses of kelp found on this coast, possibly coming out only at night. Its color is gray below and with a burnt umber tint; the upper portions dark, with black and brown reddish spots, with here and there white patches. When kept in confinement, they lie on the bottom, never moving unless touched or forced from their position.



Port Jackson Shark and Spiral Eggs. Photo Charles Ironmonger.

A DESCENDANT OF A PREHISTORIC SHARK.