THE UNITED STATES NAVAL OBSERVATORY AT WASHINGTON.

BY FREDERICK MOORE.

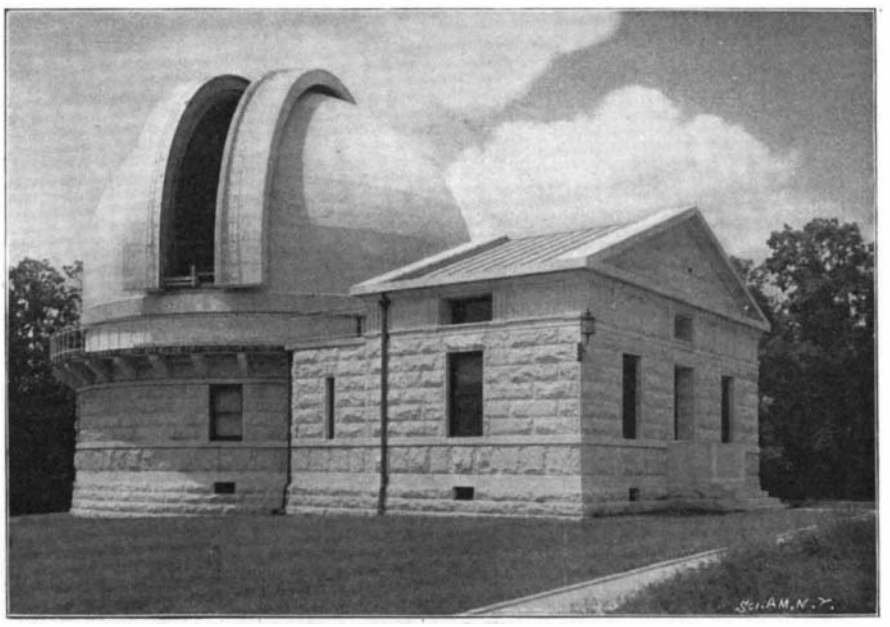
The United States Naval Observatory is the youngest among the great astronomical institutions of the nation, but it has developed in a remarkably brief time into one fit to rank with Greenwich and Poulkowa. We hear less of it, however, than we do of many of the private institutions in this country, for its object is not the further discovery of the unknown, but the development and application of the known. Of course, the former is the more brilliant object, but it would undoubtedly incur an expense to the government greater than the value of the discoveries. When a discovery is made, if it is of any importance, it has to be followed up and elaborated upon before it can be made useful to mankind. Here comes the hard work which the world does not see and here the great majority of astronomers fail.

Unfortunately the class who can see and feel the consequence of the astronomer's labor is extremely small, and it is but little realized that a second of error in a ship's chronometer at the equator means a variation of 16 2-3 miles east or west of the mariner's calculation of his position.

Recently great changes have occurred in the scientific staff of the institution by the retirement of the older professors, notably Doctors Newcomb and Hall, and the succession to their responsibilities of a younger staff, comprising Profs. Skinner, See, Updegraff, Eichelberger, Littell, and Prof. Harshman, Director of the Nautical Almanac.

It is remarkable that although in scientific achievement this country has led the way since its incipiency, it eked out the first sixty years of its existence, and attained some mighty marine achievements, practically without so indispensable an institution as a naval observatory. We depended on Greenwich, Poulkowa and Paris, and on college observatories here almost entirely until 1842.

Few visitors to Washington in the early days of the past century did not have pointed out to them from the north door of the Senate wing of the Capitol the site of the old "Washington property." The house named in our first President's will stood near the old Capitol until both were burned in 1814 by the British vandal, Cockburn. Close on this well-remembered site, stood, in 1833, an unpretending wooden structure 16 feet square, erected at the expense of a lieutenant in the navy, and equipped with a 5-foot Troughton Transit. This was our Naval Observatory in embryo. The transit was one of the instruments made for the Coast Survey under the direction and supervision of Mr. Hassler, its first superintendent, during his long detention in England throughout the war of 1812. Under an act in 1807 the institution was established, but the appointment of the superintendent did not take effect until 1811. While on a visit to London to secure instruments, then so slowly constructed, he was detained. The survey was arrested by Congress soon after his return and the instruments he had procured and the "fixed observatory" remained in statu quo. In 1832 the Coast Survey was revived, but an observatory was peremptorily forbidden by law. The transit was loaned, then, to Lieut. Wilkes for his "observatory."

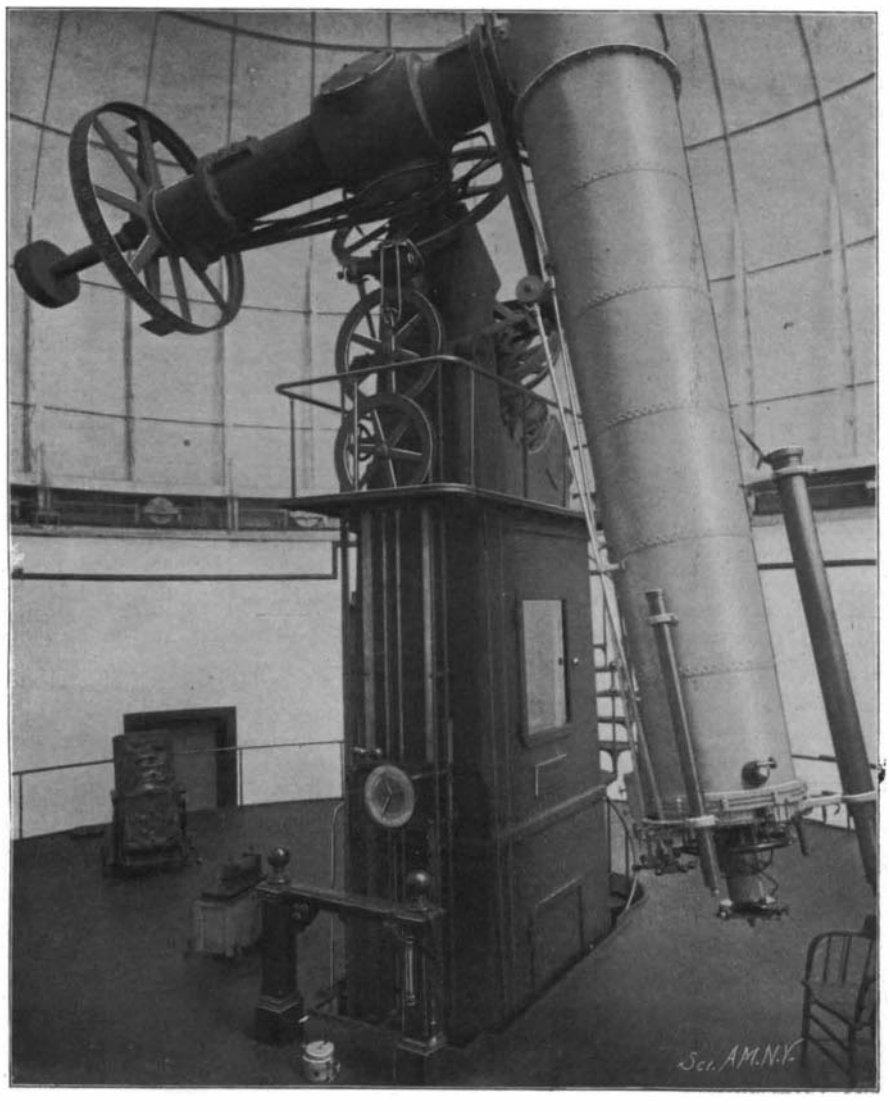


WHERE THE GREAT EQUATORIAL IS HOUSED.

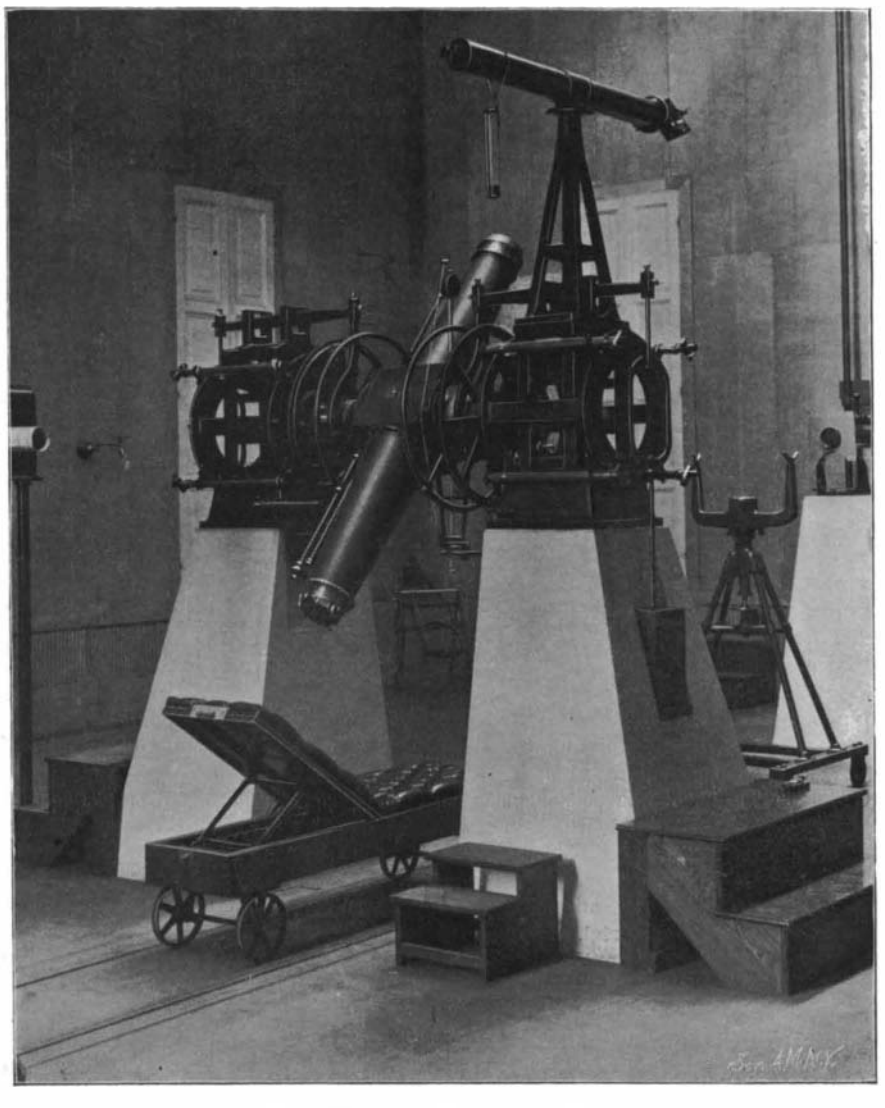
SCIENTIFIC LIBRARY OF THE NAVAL ACADEMY.

Lieut. Wilkes' observations were made only for obtaining clock errors needed for the determining of true time and the rating of naval chronometers then under his charge. The testing of all chronometers and other naval instruments used by our ships was at once found wise and useful, and the secretary of the navy took it upon himself to establish this little observatory under the name of "A Depot for Charts and Instruments," by placing an officer in charge and permitting him to have his own little observatory and do his own work. "The depot" was all Wilkes or any of his successors dared to call it until 1842, when the present institution was established.

In 1838 a new call was made upon the depot which changed the whole current of its future. An exploring expedition was about to sail for the south seas. It would be of prime importance, in determining the longitude of places visited by the expedition, that corresponding observations be taken at home to compare with those of the party, on its return. Secretary Paulding gave the observations to Lieut. Gilliss, Wilkes' successor, and Prof. Bond of Cambridge. An achromatic telescope was added to his equipment by the Navy Department and for four years Lieut. Gilliss worked diligently and accurately, bringing forth the plaudits of the



PART OF THE GREAT EQUATORIAL.



ONE OF THE SMALLER TRANSITS.

European astronomers. He continued with his insignificant equipment until finally an appropriation of $25,000 was secured—still for a depot of charts and instruments. The observatory had been urged time and again, but for partisan reasons it was as often forbidden.

The site chosen by President Tyler was fraught with historic interest. It embraced the whole of reservation No. 4, made by the old commissioners of Washington for a national university—a favorite idea of George Washington. It was the landing place of Braddock, and at a later day was known as Camp Hill, from its being occupied by the American forces the day before their advance upon the retreat from Bladensburg. The square embraced a little over 19 acres and commanded a splendid view of Washington, Alexandria, Georgetown and Arlington.

Berlin, Paris, Greenwich and Vienna presented some 200 rare volumes of the highest standard as a nucleus for an astronomical library. This branch has grown from that to one numbering 22,000 volumes and pamphlets, and stands to-day second to Poulkawa only.

The institution grew rapidly, and in 1874 installed the largest telescope then in existence, the famous 26-inch equatorial. It was set in place just in time to observe the transit of Venus, which occurs but once in a lifetime and offers a valuable method of determining the sun's parallax (the base time measurement of celestial distances). The transit is the astronomers' great event of the century and it befell Prof. Newcomb to be in charge of the greatest telescope.

The site was soon discovered to be a bad location, because, being almost in the heart of the city there was constantly some vibration, but it was not until 1884 that appropriation and other necessary bills could be gotten through Congress for the purchase of enough ground on Georgetown Heights to properly isolate the institution.

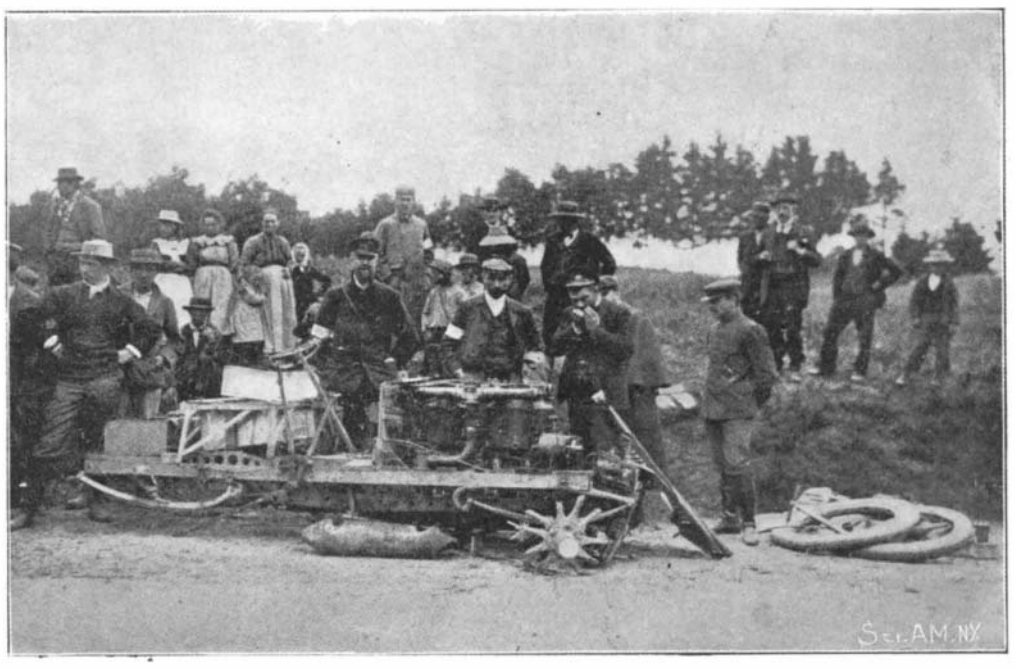
In 1893 the new home was ready for occupancy.

The dome that houses the great equatorial is a wonderful piece of mechanism. It is so perfectly balanced that its great weight of six tons can be swung or raised and lowered like a see-saw by one man without much effort. The dome rolls around on a circular wall so as to present an opening toward any part of the heavens. The whole floor rises and falls by hydraulic power to suit the convenience of the observer.

The great equatorial is in the hands of Prof. T. J. J. See, who is now at work measuring by daylight as well as by night the diameters of the principal planets and their satellites. The comparison of the daylight with the night work enables the observer to eliminate the effects of irradiation, which heretofore has been studied very little by astronomers. The light planet against the light sky of day has no irradiation as it has at night. He is also, by an elaborate series of observations in summer and in winter, making a special study of the screw of a new micrometer, designed to eliminate the effects of changes of temperature upon the scale. The degree of accuracy obtainable in this work is about one part in twenty thousand. This will give the micrometer investigation the necessary degree of refinement for the measurement of the stellar parallax, upon which he is at work also, and which is the most delicate work ever undertaken by a practical astronomer.

Beside the 26-inch equatorial, the observatory is equipped with a 9-inch transit circle, a 6-inch transit circle, a 12-inch equatorial, a prime vertical transit instrument, a 6-inch azimuth and a 40-foot photoheliograph. With this last, photographs are taken of the sun daily whenever the weather and other circumstances will permit. During last year one hundred and sixteen photographs were made of the sun. A very delicate plate with a special fine-grained lantern-slide emulsion giving contrast and fine definition has to be used, and the plates specially developed.

The effort to bring the department of meridian observations for time to a state of the highest efficiency and up to the most modern standard of requirement has included not only a recent thorough overhauling of both meridian instruments, but also an examination and improvement in the clock system. In this connection a vault was dug in the basement of the clock house, 8 feet square and 7 high. The construction of the vault is intended to be such that it will keep the temperature very nearly constant throughout the year. A 9-inch brick wall incloses the wooden house of the dimensions stated, with an air space of one foot between, which contains hot-water pipes for heating. The whole is roofed over with boards inclosing a 6-inch layer of asbestos wool. The vault contains three brick piers for clocks and one smaller pier which may be used in mounting a pendulum apparatus for testing the minor irregularities of clock rates. Triple doors are provided and means for slow ventilation. The location is on the summit of a hill, and drainage conditions are such that the basement in which the vault is situated is remarkably dry. There is little fear of damage from rust. In the early days of the observatory, in a similar experiment the clock built by Kessels, a most delicate instrument, and the most valuable of its kind in the country, was almost ruined.



THE WRECK OF JENATZY'S CAR.

An observation for time is taken about every other day. There are three standard clocks always in use and two to which the Western Union wires are attached for transmitting the noon signals. Every day, except Sundays, these signals go out. An average error of 0.13 seconds is recorded for the past year. The Kessels clock will not stand being attached to the wires, and with the others it gives the time about as accurately as it can be given. The chronometer room is maintained at an even temperature and is treated almost as delicately as is the room for the great clocks.

A NEW SCHNEIDER-CANET NAVAL GUN.

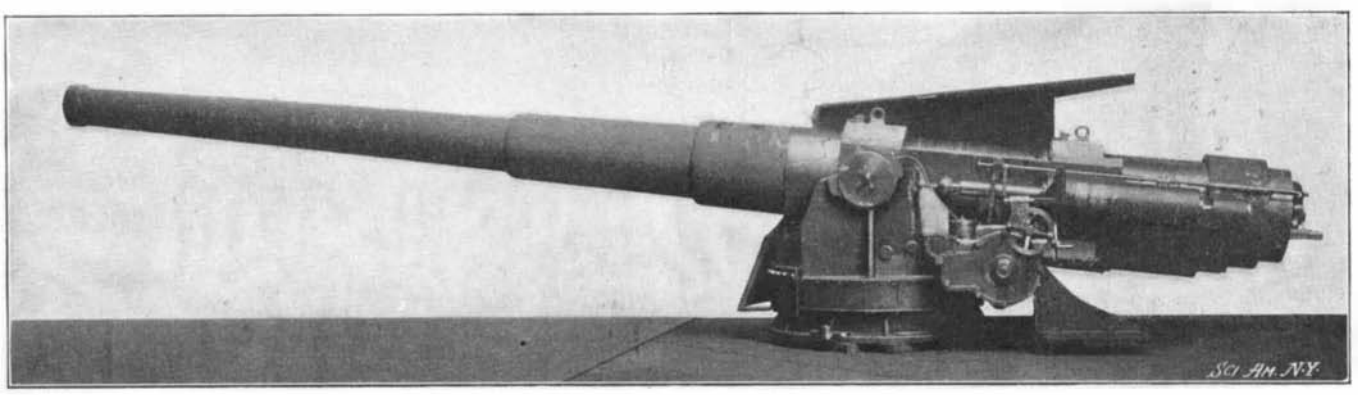
Our illustration shows a new 9.45-inch gun for naval or coast defence purposes, which has recently been brought out by the well-known French firm of Schneider & Co. The weight of the gun itself with breech mechanism is 20½ tons, while that of the carriage without the shield is 13¼ tons. The projectile used weighs 330 pounds and its initial velocity is 2,780 feet per second.

The diameter of the gun at the breech end is 36.22 inches. The breech is closed by a plastic obturator, or metallic plug, that can be locked in place or withdrawn by three and a half turns of the operating handle. Electric or percussion firing is employed as desired, with single control on the left of the gun-carriage. This mechanism is easily accessible for the gunner, who is suitably protected against premature discharges.

The gun-carriage is of forged steel and carries two diametrically opposite recoil cylinders, as well as a compressed-air recuperator, which is independent of them and is placed on the lower side. The recoil cylinders are suitably arranged for putting the gun out of or in battery by means of a pump. This enables the gunner to continue firing in case of damage to the recuperator, whatever may be the angle of elevation.

Vertical aiming is facilitated by the interposition of live roller rings between the trunnions of the carriage and the trunnion bedplate of the frame. The elevating hand-wheel, which is placed conveniently for the gunner, drives a toothed sector fastened to the carriage, by means of an endless screw and special helicoidal wheel furnished with friction packing washers to avoid shocks when firing. Horizontal aiming is accomplished by the traversing of the whole carriage, which turns on a ball-bearing traverse base ring. It is traversed by a hand wheel turned by the gunner. This wheel is connected with a pinion that meshes with a circular rack fastened by means of an irreversible mechanism of great efficiency. This mechanism, while assuring the absolute irreversibility of the system, permits of one man revolving the movable weight of 40¾ tons at a sufficiently rapid rate to follow an object moving at a speed of 34 knots and distant 1,640 feet.

Finally, this new 9.45-inch gun on a naval carriage offers the same facility of manipulation as has heretofore been obtained with rapid-fire guns of smaller bore.



SCHNEIDER-CANET 9.45-INCH GUN ON NAVAL MOUNT.

Weight of Gun, 20.5 tons. Weight of Projectile, 330 pounds. Initial Velocity, 2,780 feet. Muzzle Energy, 17,748 tons. Theoretical Perforation of Iron at Muzzle. 32.8 inches per second.

THE ARDENNES CIRCUIT.

With the completion of the *Circuit des Ardennes*, Englishmen have again scored a signal victory. The winner of the race was Mr. Charles Jarrott, who finished some nine minutes ahead of his nearest competitor, in a 70 horse power Panhard.

The race was run on a sort of huge track, measuring 85.4 kilometers to the lap, with no great grades to speak of. There were no controls, no halts of any kind to check the contestants. The race may, therefore, be regarded simply as a test of powerfully engined, high-geared cars under conditions offering the least resistance. For that reason the contest stands in sharp contrast to the hilly Paris-Vienna race.

Eighty-five kilometers in the opinion of many is a rather short lap. Indeed, the many accidents which happened in the circuit amply bear out the criticisms that have been made on this score. Pierre de Crawhaze, toward the end of a third lap, collided with M. Coppee. One wheel of de Crawhaze's car flew off, the other broke from the axle, and the car was dragged along for two hundred yards. No one was hurt. On the second lap one of Jenatzy's front wheels whirled through the air, while the car was traveling at about 65 miles an hour. The vehicle was overturned, and the driver and his assistant crawled out from under the ruins, not seriously injured. De Caters, on a Mors, was lost on the third lap in a cloud of dust raised by Jarrott, jumped on a wall, and impaled his car. On the same lap Roland in a Gobron-Brillié ran off the road and out of the race. Charron collided with a carriage at a speed of 90 kilometers an hour, and reduced his own vehicle and the carriage to splinters and scrap iron.

The race itself offered not a little excitement. It was a nip and tuck struggle between Jarrott and Gabriel. They were never more than 6 minutes apart at any of the turning points. For a long time it was uncertain whether Jarrott or Gabriel would win. At the end of the first lap Gabriel had gained two minutes; at the second he had gained one minute. At the half Jarrott led by less than half a minute. When