THE NEW ASTEROID CAMERA AT THE UNITED STATES NAVAL OBSERVATORY.

BY C. H. CLAUDY.

It is somewhat difficult for the layman to understand the uses and necessities of some of the more obscure departments of astronomical work. Of what use, he asks, is the accurate determination of the parallax of some small and faint star, or the plotting of the orbits of some of the asteroids? But things astronomical, like things terrestrial, have a fashion of depending very much upon each other; and to continue the instance just mentioned, the accurate measurement of the solar constant, most important to navigators, depends upon a great many factors, of which asteroid observations, or at least observations upon Eros, the nearest of these little bodies, is not the least important.

As everyone knows, asteroids are tiny little planets revolving about the sun between the orbits of the major planets Mars and Jupiter. Foreshadowed by Bode's law, now discredited, hunted for by an association of astronomers, the first asteroid was discovered by an independent observer, who called his discovery Ceres. Now there are several hundreds of the little bodies known, but as others are constantly being discovered, the field is not yet closed. Of course, all the brighter ones, and consequently the largest and most important, have been discovered, but the little ones present problems of interest not to be despised. The old way of setting about discovering an asteroid was to compare a suspected region of the sky with a chart, and if anything was to be seen not on the chart, to observe it for movement. This was a tiresome, tedious, and not particularly reliable operation. Now the astronomer turns his heavenly camera on the sky, and when he finds a small trail or line on the plate, instead of a point, he knows that the particular heavenly body which made that trail was within the planetary system, and consequently an asteroid.

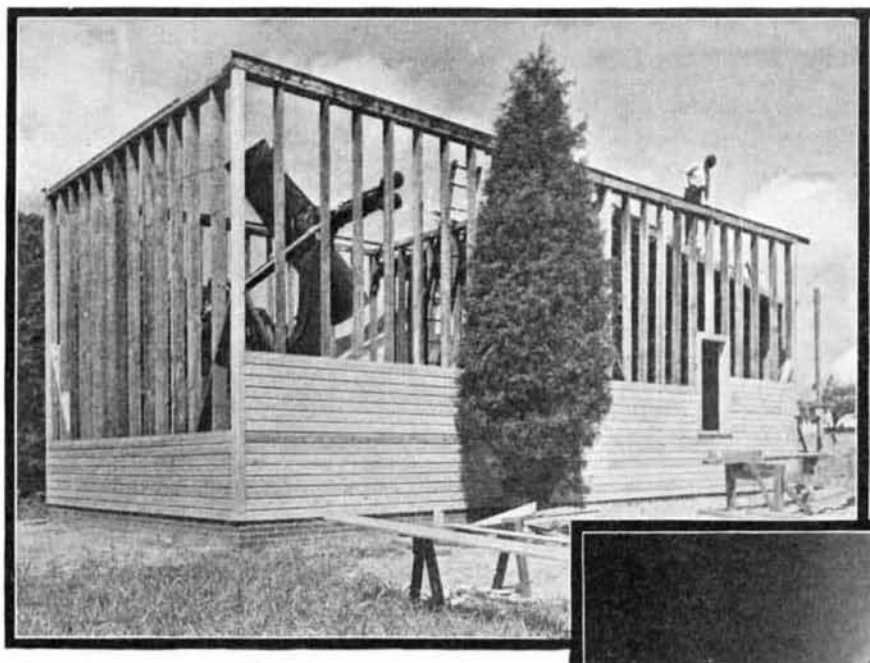
At the Naval Observatory, Washington, there has been in use for some time a camera with a nine-inch lens, attached to the great equatorial telescope. Of course, when the camera is being used, the great instrument is out of commission, only the mechanism which moves it being used. For it should be clearly understood that taking pictures of the stars is an affair of some time, exposures of from one to three hours being given. During this time, of course, the earth is turning about its axis, and the stars are traveling across the heavens from east to west. So it is necessary to keep the camera moving with the stars, or all of them would make trails, and the value of the observation be lost. This keeping the camera in motion toward the west as fast as the earth turns to the east is accomplished by having the instrument mounted equatorially, or, as in the present case, attached to some other instrument's equatorial mounting. An equatorial mounting, be it understood, is one which has two axes, one in the plane of the earth's axis, the other in the plane of the earth's equator. The polar axis is revolved at a speed which would carry it around once in a sidereal day, so that it exactly compensates for the motion of the earth around its axis.

Now this camera which is mounted on the big telescope does very good work, but it sadly interferes with the regular work of the big telescope. At the same time, the purchase of a new equatorial mounting, big enough and strong enough to do the work well, is an expensive matter and one which the powers who have charge of the Congressional appropriation would be slow to advise. Matters being in this state, Mr. Dinwiddie, of the Observatory staff, proposed that a double asteroid camera be constructed out of the old equatorial mounting which was put in the junk-pile when the Observatory moved to its present site in 1893. Aided by the far-sighted policy of Admiral Chester, in charge of the Observatory, Mr. Dinwiddie took the modest appropriation which was allowed and set to work.

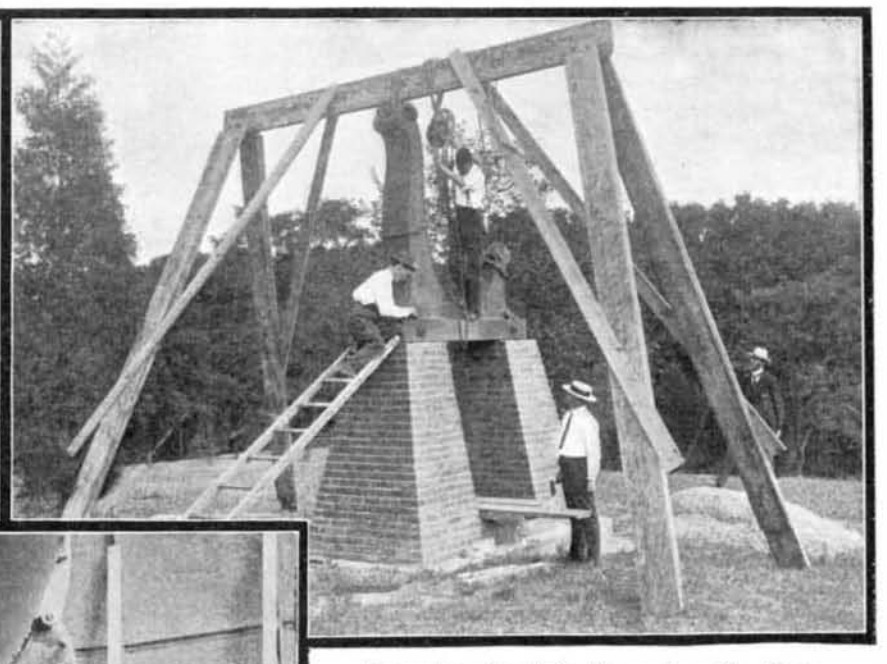
The first thing to do was to make the plans. The next, to overhaul the discarded mounting and put it together in fit condition to work. This being done, an accurate template was made of the base of the iron mounting, which was used to set the bolts, firmly fixed in cement, at the top of the piers, solidly set on a cement foundation, in the southern part of the Observatory grounds. The piers being constructed, the next thing was to raise the huge iron support for the polar axis in position and bolt it home. This was accomplished with the aid of the scaffolding shown in the illustration, a chain-hoist, worked by man-power, and a little help from other Observatory employés. The scaffolding was limited in size by the length of the timbers which could be conveniently obtained, so that the setting of the iron was somewhat complicated. It was necessary to first raise it as far as possible with a top hoist, and then take hold below the center of gravity, steadying the mass with guys. In this way it was finally placed in position, and shortly afterward the other axis and the central section of the old telescope were placed in position.

A wall of brick and cement was then built around the piers and on this a house erected, Mr. Dinwiddie doing much of the work himself. This house, or shelter, as it is locally termed, is of peculiar construction. It has two rooms, one containing the telescope, the other to be used either for a dark-room or as observers' quarters. The roof over the telescope is mounted on wheels, which run on rails the whole length of the building. When the telescope is to be used, this roof will be slid off its permanent position back over the roof of the second room, thus leaving the telescope free to the heavens. All this can be plainly understood by reference to the accompanying photographs.

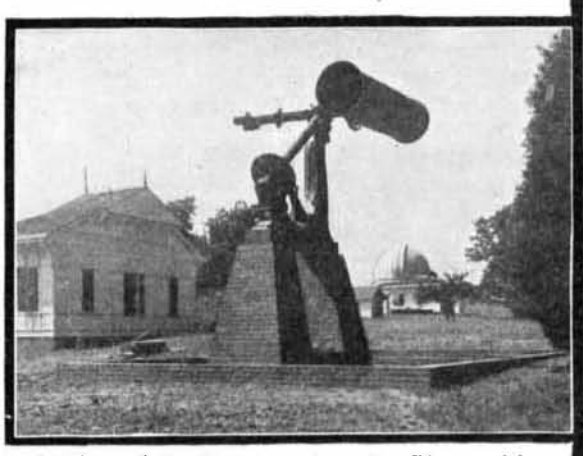
When completed, the central section of the telescope tube, which is all that will be carried by the mounting, will have on each side of it a duplicate camera, with separate lens of its own—duplicate, because it sometimes happens that there is a flaw in the plate, causing the observer much lost time and worry. By taking two plates, exactly alike, there will be no possibility of mistaking a flaw for an asteroid, as it is hardly conceivable that the same flaw in the same place should appear in two plates. Through the center of the tube will be a telescope, used for finding and for following.



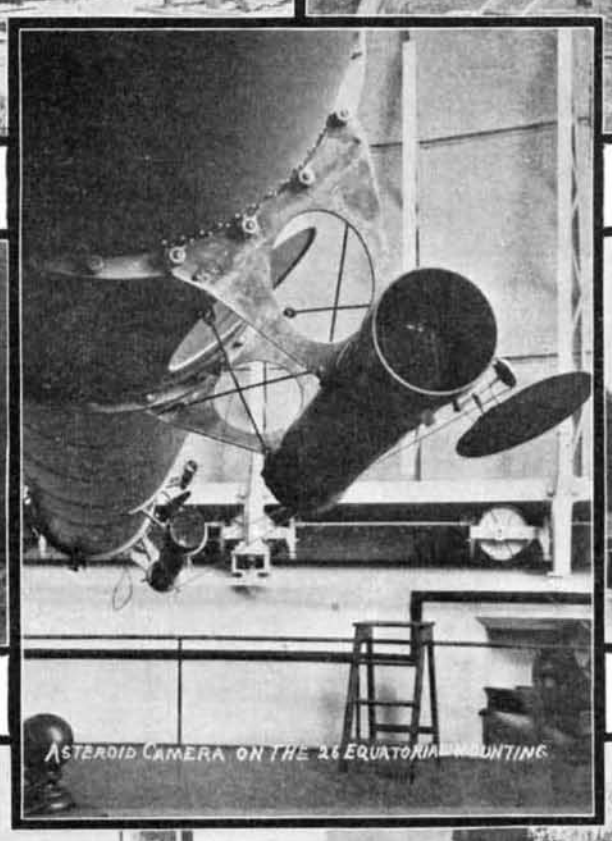
Erecting Photographic Telescope and Shelter.



Lowering the Axis Support on the Piers.



A View of the Instrument on the Piers, with Equatorial Dome in the Distance.



The Instrument Completely Mounted.

The Masonry Piers.

It may be asked why it is necessary to follow a star if the clockwork turns the telescope and keeps an object oriented in spite of the earth's motion. The reply may be that although the accuracy of the clocks which drive the telescopes is remarkable, they are not absolutely accurate and occasionally vary in rate. So an occasional visual observation is necessary to keep the whole accurately pointed. The telescope is so manipulated that a certain star is exactly on the crosshair in the eyepiece. Should the star get away a little bit, the observer can immediately correct the movement, and as the exposure is so long, such a variation for a short time is ineffectual.

The work has been going on since June, and is rapidly nearing completion. When it is finished, the Observatory will have an asteroid camera which will not only relieve the great equatorial from work for which it was not designed, but an instrument second to none in effectiveness. Incidentally, Admiral Chester will see a tangible, new instrument come into being during his administration; and Mr. Dinwiddie, who planned and carried out the undertaking in the face of such discouragement from many who said the task could not be done, will have cause to triumph, not only in the fact that he has made this apparatus, but that he has put to legitimate use a valuable telescopic mounting which for eleven years has rusted in the scrap-heap.

JAPAN AT THE ST. LOUIS FAIR.

(*Continued from page* 376.)

houses where refreshments are served at all times. There are also a Japanese bazar and several resting places of characteristic architecture. In the gardens surrounding the administration building a successful effort has been made to reproduce the best features of Japanese landscape gardening; so well has this been done that travelers who are familiar with Japan state that they can readily imagine themselves back in the Island Kingdom.

While the outdoor beauties of Japan attract the World's Fair visitor, it is the magnificent handiwork of the Japanese people that makes the most lasting impression. In the Palace of Varied Industries is an exhibit of the most beautiful cloisonné ware ever exported from Japan. This famous ware has never been equaled by any other people. To manufacture the finest quality of it takes nearly a year's time, separate burning and polishing being required for every distinct color used, and these vases and urns are ornamented with pictures in many colors. In nothing else are such brilliant colors to be seen. The decorations consist of flowers, birds, fish, and landscapes in every conceivable shade and color. The process of making this ware is a Japanese secret carefully preserved. Some of these cloisonné vases are valued at several thousand dollars each. They are in all shapes and sizes, from a few inches to eight feet high. There is also a great display of Japanese porcelain ware of many varieties, sizes, and colors, and thousands of bronzes that are highly artistic. The carving is unexcelled, the expression being wonderfully lifelike. Elaborately carved furniture is to be seen in many varieties. The coloring is of the rich and artistic character for which the Japanese are so famous. There are magnificently-carved cabinets of red and black lacquer and gold, and lacquer tea tables inlaid with gold and fine woods.

Passing from the beauties in wood, metal, and porcelain, the visitor approaches a most elaborate and varied display of fine embroidery. Here are kimonos in rich silk, embroidered in most beautiful colors, and various other articles in silk, such as parasols, fans, curtains and wall ornaments. Just beyond are many fine pictures of animals, birds, and landscapes, embroidered in silk. No oil paintings were ever more perfect or more true to life. There is one picture of a cockfight, with feathers flying in the air, so natural in appearance that the scene seems real and the birds actually alive.

There are elaborately embroidered screens which required years to make; magnificent silk shawls, handkerchiefs and other articles for ladies, and thousands of yards of the finest silks; toys in endless variety, fine furs, displays of the best native work in painting and gilding on leather, a great collection of Japanese hats, Japanese lanterns of all sizes, shapes and colors, and a bewildering variety of other art treasures that bear the stamp of Japanese excellence.

A model of a silk factory is a feature of the exhibit, and here, too, the Japanese thoroughness is manifest in every detail. There is a model of the house where the silkworms are reared and cared for. Another building shows where the silk is spun and woven, and the entire process of silk culture is fully displayed.

In the Palace of Education the Japanese exhibit offers another surprise. All the schools of Japan have displays, and more evidences of Japanese thoroughness and attention to detail are given. Charts show the school attendance, averages, the number of readers in libraries, number of copies of journals published, expenditures, etc. The Japanese school course consists of eight years in the primary, five years in the intermediate, three years in the high school and in the university three or four years. They have three kindergartens also and their technical schools, normal schools, and agricultural schools, besides their regular paid institutes, just as they exist in Europe and America. In the public schools the boys are taught bronze work, wood carving, lacquer work, and to paint in water colors, and the girls are taught embroidery. Great care is shown in the methods employed, and nothing is omitted that might aid in perfecting the education of Japanese children.

The busy Japanese are fully alive to their fishery interests, and have an extensive display of fishing boats, tackle, and fishing appliances of every description in their well-equipped section in the Forestry, Fish, and Game Building. Nine distinct varieties of fishing boats are shown.

In the Palace of Agriculture Japan's agricultural display asserts itself. It is in charge of K. N. Ohashi, Japanese commissioner to the World's Fair, and is arranged with great taste as well as completeness. The rice exhibit is the principal feature, and every phase of rice culture is minutely shown. The grain is taken from the time it sprouts, to the matured stalk bearing the ripened rice, twenty varieties of which are exhibited. The insects that injure rice are shown in glass cases, and the diseases affecting rice are shown in their several stages of development. The methods of hunting the insects are illustrated in photographs and drawings. A large display of fruits is exhibited, the Japanese persimmon being present in many varieties. Fruit culture in all stages is seen in pictures and drawings. The culture of tea and methods of growing tea scientifically are shown in detail, even the fertilizers required by certain soils being displayed. There is a tobacco exhibit of considerable magnitude. In Japan tobacco is a government monopoly. The exhibit shows the land desirable for tobacco and the methods of tobacco culture.

At the doorway of the Japanese exhibit of agriculture is a beautiful show-case in the form of a jinrikisha, made of gold and lacquer and valued at $1,000, and a large bush of flowers made entirely of silk.

The important coal-mining interests in Japan are well represented in the Mines Building. We have selected for illustration a complete working model of what is known as Manda Pit, one of six mines owned by the Mitsui Mining Company, of Tokyo, Japan. The shaft has a cross section of 41 feet by 12 feet with a central division for the operation of two separate cages. The head gear above the shaft is 100 feet in height and the head sheave is 17 feet in diameter. The double-cylinder steam capstan engine, represented faithfully to scale in the model, was built by the Müke Engine Works. The steam cylinder is 10 inches diameter by 10 inches stroke, the drum is 6 feet in diameter, and the engine is capable of hoisting a load of 30 tons. There is also a double-cylinder winding engine with cylinders 24 inches in diameter by 5 feet stroke; the winding rope has a circumference of 4½ inches, and the period of one winding is 50 seconds. The model also reproduces to scale the compound condensing steam pumping engine, with steam cylinders 45 inches and 90 inches diameter by 12 feet stroke, and water cylinder 22 inches in diameter. There is also represented a tandem compound screen engine, built at the Müke Engineering Works, Japan, the cylinders being 13 inches and 24 inches diameter by 20 inches stroke. The model also reproduces the screening plant, with revolving tipper 4 feet 10 inches in diameter, capable of tipping three tubs of 1,500 pounds capacity each per minute; a rotating bar screen 5 feet wide by 14 feet long; a gyrating screen 5 feet by 14 feet, a picking traveling band and a belt conveyor. Nearly all of the machinery and general plant represented by the model, and the model itself, were made in Japan, and the whole model affords a comprehensive idea of Japanese advancement in this branch of heavy engineering work.

Limitations of space prevent any detailed references to the exhibit in the Transportation Building, with its large relief maps of the Japanese Empire, on which are marked all the railway, steamship, telegraph, and telephone lines, and the fine display of steamship models, which together speak eloquently of the development of this, the latest of the ancient races to put on the garb of modern civilization.

The Current Supplement.

The current SUPPLEMENT, No. 1508, opens with an interesting article by Dr. Alfred Gradenwitz on some striking repair work done on the steamship "Ekliptika." Excellent illustrations showing the nature of the damage sustained by the craft are published. Emile Guarini describes a very simple portable electric searchlight plant used by the British War Office. "Electrical Transmission Devices for Automobiles" is the title of an article by the Paris correspondent of the SCIENTIFIC AMERICAN, in which he describes the Jeantaud and the "Electrogenia" systems. Perhaps the most valuable article contributed to the current SUPPLEMENT is that by Sir William Ramsay on the "Periodic Arrangement of the Elements." The article is written in a lucid, instructive way that will surely be appreciated at its true worth. Day Allen Willey tells by word and picture how an incandescent mantle is made. Douglas W. Freshfield read before the recent meeting of the British Association for the Advancement of Science a paper on "Mountains and Mankind," the first part of which is published in the current SUPPLEMENT. J. S. V. Bickford thoroughly discusses carbureters.

"American Estates and Gardens."*

This sumptuously illustrated book by Barr Ferree, Esq., treats of the more notable great estates, houses, and gardens in America. It is a volume of 340 pages, with 275 illustrations, of which eight are in duotone and many are full pages.

The illustrations are exclusively from original photographs. They comprise examples of the best work of the most distinguished American architects, and illustrate the most modern tendencies in the design and construction of large houses. The unusual number of illustrations contained in the book, which include exteriors and interiors, together with many garden views, has rendered it possible to illustrate the homes and their surroundings with a degree of completeness not before attempted. The garden views present many of the more recent notable gardens, and constitute a noteworthy feature of the book.

The letterpress has been prepared by Mr. Barr Ferree, and consists of detailed descriptions of the houses and gardens illustrated. The author has an extended personal knowledge of contemporary architecture, and his wide experience as an architectural writer has especially qualified him for this work. A unique value is imparted to the work by the fact that the descriptions are those of a keen observer, fully in sympathy with the beautiful houses he describes.

The book has been prepared for the general reader, and appeals alike to the architect and the house owner, to every one, indeed, who is interested in good building and in the finest types of recent domestic architecture in America.

The work has been beautifully printed on heavy plate paper, the size of the page being 10½ by 13½ inches. It is handsomely bound in green, black, and gold, and in addition to being the standard book on notable houses and gardens in America, it is one of the most attractive gift books of the year.

18,187,918 School Children.

More than 16,000,000 pupils, or 20.04 per cent of the entire population, were enrolled in the common schools of the country in the fiscal year ended June 30, 1904. The total school enrollment for the year, including public and private, elementary, secondary and higher education, was 17,539,478 pupils, and to this there should be an addition made for evening schools, business schools, private kindergartens, Indian schools, State schools for defectives, orphans, etc., 648,440, making a grand total of 18,187,918.

These figures are taken from the annual report of the United States Commissioner of Education. In 1870 the number of pupils enrolled in common schools was 6,871,522, the same being 17.82 per cent of the population. In 1880 the percentage enrolled had increased somewhat, being 19.67 per cent of the population. In 1890 the percentage of the total population was somewhat in excess of the present rate.

The average daily attendance for 1903 was 11,054,502, the same being 69.2 per cent of the total number enrolled. This is the largest average attendance on the number enrolled ever reported in the United States. It was only 59.3 per cent in 1870.

Women are rapidly supplanting men as school teachers. Male teachers formed nearly 39 per cent of the entire number in 1870, and nearly 43 per cent in 1880, but only 34 per cent in 1890, and only 26 per cent in 1903.

The average monthly wages of teachers for 1903 was $49.98 for males and $40.51 for females, a slight increase over the previous year.

According to an estimate of the report the total amount of schooling given to the average of population has risen from 82 days in 1800 to 1,034 days in 1903.

Experiments have been carried out by the British naval authorities with a new method for combating submarine vessels. This device comprises a new type of quick-firing torpedo. This missile is less than 6 inches in diameter and carries, of course, a smaller explosive charge than the 18-inch weapon, while furthermore it is not provided with a gyroscope. The new torpedo is fired from an above-water tube, and the mechanism is so arranged that the weapon sinks when it has reached its limit of range, if the object at which it was discharged is missed. The trials are being carried out at Portsmouth and are being followed with great interest, as it is considered a more effective means of fighting the submarine than the system of entangling them in wire nets.

* Quarto, 340 pages, 275 illustrations. Munn & Co. Price $10.