GENERAL REPORT

OF THE

ECLIPSE EXPEDITION IN 1905.

Rear Admiral COLBY M. CHESTER, U. S. N., in charge.

The U. S. Naval Observatory expedition to observe the total solar eclipse of August 30, 1905, rendered possible by the liberality of Congress in making an appropriation of \$5,000 and the hearty cooperation of the Navy Department, was sent out in connection with a special line squadron of three vessels detailed by the Navy Department, with the superintendent of the Observatory, Rear Admiral C. M. CHESTER, U. S. N., as commander in chief. This squadron consisted of the protected cruiser U. S. S. *Minneapolis* (flagship), Capt. JAMES M. MILLER, U. S. N.; the converted cruiser U. S. S. *Dixie*, Capt. GREENLEAF A. MERRIAM, U. S. N.; and the collier U. S. S. *Cæsar*, Commander GEO. H. STAFFORD, U. S. N.

Rear Admiral CHESTER, commander in chief of the expedition, with several members of the eclipse party, sailed from New York, July 3, on the U. S. S. *Minneapolis* (flagship), arriving at Grao, the port of Valencia, Spain, July 20, the U. S. S. *Cæsar* having already arrived with the freight and other members of the expedition. In the meantime the U. S. S. *Dixie* had proceeded to Bona, Algeria, with the party that was to establish a station in Africa. Three principal stations were established: One near the central line at Daroca, on the highlands of the Spanish peninsula, at an altitude of about 2,500 feet; one near the southern edge at Porta Coeli, a few miles from the Mediterranean coast of Spain, at an altitude of about 1,000 feet; and one near the central line at Guelma, Algeria, about 40 miles from the coast, at an elevation of about 1,500 feet. At Daroca Prof. of Mathematics W. S. EICHELBERGER was in charge. At Porta Coeli Prof. of Mathematics F. B. LITTELL was in charge of the installation, to be relieved by Lieut. Commander E. E. HAYDEN when the whole party of observers was assembled. Rear Admiral CHESTER took station here during the eclipse. At Guelma Capt. J. A. NORRIS was in charge.

When it was decided to equip three stations completely for photographing the corona with long and short focus cameras, and for spectroscopic work, it was found that it would be necessary to supplement and remodel the available apparatus on hand to a considerable extent. A new 7.5-inch lens of 65 feet focal length was made by BRASHEAR. Two new coelostats, designed by Computer W. W. DINWIDDIE, were made by WM. GAERTNER & Co., of Chicago. The rest of the new apparatus required was constructed at the Observatory under the direction of Mr. DINWIDDIE. Three polar axes were made, 10 feet long, of steel and iron construction, so arranged that the cameras were hung within the frame. The tubes of the cameras to be used on the polar axes consisted of similar latticed iron framework

lined with black velvet and covered with sheeting soaked in a mixture of linseed oil and lampblack. One new grating-holder was made, supporting the grating from both sides of the camera frame, which was also of steel construction. Three portable dark rooms for developing were constructed; also three portable dark rooms for the long-focus cameras, and three tubes similar to the one used by Professor BARNARD in Sumatra in 1901, but with ventilating doors on the under sides to be left open until a few minutes before totality.

Each station was equipped for the determination of latitude and longitude. At the two Spanish stations time signals were received from the Madrid Observatory over special wires kindly erected by the Spanish Government, and at the African station signals were received from the Algiers Observatory. The latitudes were determined by TALCOTT's method.

Each station was supplied with one of the long-focus cameras mounted horizontally, the one at Porta Coeli having the new lens of 65 feet focal length, the other two stations having lenses of 40 feet focal length. There was also at each station one of the polar axes for carrying one or two cameras for obtaining coronal extension, together with spectroscopic and polariscopic apparatus.

Each station was supplied with one or two gratings to secure large-scale photographs of the flash spectrum and the coronal spectrum.

At each station a complete meteorological equipment was set up, and provision was also made for magnetic and photometric observations.

At none of the stations was there any interference from clouds, and the programs in general were carried out as planned.

The contacts were observed at all the stations and were noted about 20 seconds ahead of the predicted time.

Several parties of sailors, in charge of officers from the naval vessels, made drawings of the corona and shadow-band observations. One of these parties, in charge of the commanding officer of that ship, Capt. J. M. MILLER, U. S. N., was located on board the U. S. S. *Minneapolis* (flagship) near the central line off the east coast of Spain; another under the charge of Commander G. A. MERRIAM, U. S. N., was located on board the U. S. S. *Dixie* near Bona, Algeria.

Thirty-six photographs of the corona were taken at the three stations. At Daroca Assistant L. G. HOXTON obtained seven with the 40-foot camera, the exposure times being 0^s.5, 2^s, 5^s, 45^s, 120^s, 5^s, and snapshot; Paymaster H. R. INSLEY, U. S. N., obtained three with the 12-foot camera of 5^s, 70^s, and 10^s exposure; and Midshipman E. W. CHAFEE, U. S. N., obtained three with the 36-inch DALLMEYER camera and color screen of 5^s, 70^s, and 40^s exposure.

At Porta Coeli Photographer G. H. PETERS obtained seven with the 65-foot camera of 2^s, 3^s, 35^s, 5^s, 15^s, 3^s, and 2^s exposure, and Assistant Astronomer G. A. HILL obtained four with the 104-inch camera of 5^s, 10^s, 40^s, and 22^s exposure.

At Guelma Mr. W. W. DINWIDDIE obtained eight with the 40-foot camera, the exposure times being 2^s, 5^s, 13^s, 88^s, 27^s, 4^s, 4^s, and 0^s.25 10 seconds after the third contact, and Yeoman F. A. ACHEN obtained four with the 15-foot camera, of 30^s, 55^s, 90^s, and 10^s exposure. On the last negative, with the 40-foot camera

at Guelma, taken 10 seconds after third contact, the entire ring of the corona is visible and the prominences on the bright limb are shown in fine detail.

For each station there has been made, by Assistant Astronomer H. R. MORGAN, a composite drawing containing all the features discernible on the negatives secured with the long-focus camera at that station. The duration of totality at the two central stations, Daroca and Guelma, was nearly the same, and the instruments were similar, 40-foot photoheliograph of 5-inch aperture, but the longest exposure at Daroca was 120^s and at Guelma only 88^s, so that greater extension of the corona was secured at the former station. There are differences in detail shown in the drawings for these two stations which are clearly apparent on the negatives, yet it is not considered certain that these differences might not be due to differences of exposure and development. At Porta Coeli, near the southern edge of the path of totality, the longest exposure was only 35^s, the plan being to obtain only the inner corona with the 65-foot photoheliograph of 6.5 inches aperture. The drawing showing the form and extension of the outer corona has been made from the photographs made with the shorter focus cameras.

The drawings of the large prominence visible on the eastern limb of the Sun at second contact show the decided changes that took place between the time of totality at Daroca and that at Guelma, a difference of 21.5 minutes.

Over 40 spectrograms were obtained with the various spectrographs, the details concerning them being given in the reports of the separate stations.

The report by Prof. F. H. BIGELOW of the U. S. Weather Bureau on the meteorological work contains not only the results obtained at the three eclipse stations but also those from five other stations established in Spain and Africa and those obtained on the trip of the U. S. S. *Cæsar* from America to Europe and on the return trip. This report follows the reports from the three eclipse stations.