patches on her surface will feel satisfied that this well-known observer has not yet detected such tracings as have been put before us by Lowell. Venus was frequently observed by him with the 12-inch refractor of the Mount Hamilton Observatory during the years 1888–95, but as he says he "never could (with but one exception) satisfactorily see the markings. Vague indefinite spots were often visible, but it was not possible to see them well enough to identify them for rotational purposes." With these facts before us, it is not then surprising that the observed periods of the planet should vary from twenty-three or twenty-four hours to 225 days. The exceptional case of good seeing mentioned above was "when the air was thick with smoke and dust. . . . I was struck with the remarkably perfect definition. There was not the slightest tremor. The markings on the surface of the planet were distinctly seen, though they were difficult and very delicate." The drawing which accompanies Prof. Barnard's description shows the crescent of Venus with four large hazy patches very much foreshortened in their position near the limb.

To continue his series of measurements of the diameters of all the planets with the 36-inch, Prof. Barnard, in May, June and July of 1895, undertook that of Venus. The mean of all his measures reduced to unit distance gave a diameter of 17″·397, corresponding to an actual diameter of 7826 miles.

This value seems to be very satisfactory when compared with the mean of all previous determinations, as will be seen in the following table.

Hartwig ...	Breslau heliometer	17″·67
,, ...	Reduction of Oxford measures ...	17·582
,, ...	Double image observations by Kaiser	17·409
,, ...	Nine measures in Bahia-Blanca ...	17·406
Peter ...	Two measures in Bahia-Blanca ...	17·216
Küstner ...	Two measures in Punta Arenas ...	17·312
Auwers ...	Measures during transit	16·801
Ambronn...	Göttingen heliometer	17·711
	Mean	17·389
Barnard...	36-inch Lick refractor...	17·397

NEBULÆ UNRECORDED IN CATALOGUES.—In the current number of the *Observatory*, Dr. Roberts gives a list of several nebulæ which have not found a place in catalogues, but which have been recorded on the plates used in his photographic survey. These photographs were taken with his fine 20-inch reflector at Crowborough, and a comparison between these and the recorded places of nebulæ in the "New General Catalogue," and the "Index Catalogue," by Dr. Dreyer, has been fruitful of many discoveries. Of the seventeen new nebulæ, we extract the following description of the largest :—

Region of ♅ I. 157 Trianguli, N.G.C. 672; Nova, R.A. 1h. 39m. 39s. N.P.D. 63° 22′·3.—It is nearly as large and prominent as ♅ I. 157, and distant from centre to centre 8′ only; nucleus consists of six faint stellar condensations forming a straight line in the direction south, following to north preceding, and there are six or seven very faint condensations of nebulosity near the preceding margin; 15th mag. star on the north preceding margin, and a 16th mag. star at the south following end of the nucleus, 1896 November 29.

It is remarkable that this object should have escaped detection by the many keen-eyed observers who have examined the nebula ♅ I. 157, which is only four minutes of arc distance from it; and it appears to me that we are justified by the evidence in inferring that this nebula has come into the state of visibility during the past half-century. Lord Rosse, in 1896, made several observations of the nebula adjoining, but does not refer to this one. It is remarkable also that the nuclei of the two nebulæ are straight lines of faint nebulous stars immersed in nebulosity, and they are so clearly depicted on the photograph that I think they should be visible to the eye by the aid of telescopic power.

Dr. Roberts finds further, by examining his negatives, that two classes of stars, which he terms "faint" and "small," attract notice. The former have small bright nuclei surrounded by nebulosity, and are quite distinct from the latter, which appear as small round spots without a nucleus. These, he states, would, if they were classified, come under the heading, "small circular nebulæ with small bright stellar nuclei."

HARVARD COLLEGE OBSERVATORY ZONE OBSERVATIONS.—Volume xxxvi. of the *Annals* of the Astronomical Observatory of Harvard College contains the journal of the zone observations of stars between 49° 50′ and 55° 10′ of North Declination. These observations were made with the meridian circle during the ten years 1875 to 1885 by Mr. William Rogers, under the direction of the successive directors Joseph Winlock and E. C. Pickering. The present volume completes the journal begun in volume xxxv., and in this review all doubtful cases have been re-examined.

THE ROYAL OBSERVATORY, GREENWICH.

THE Astronomer Royal presented his annual report on Saturday last to the Board of Visitors of the Royal Observatory, Greenwich. Among the numerous guests were many astronomers and men of science, who inspected the buildings and instruments, especially those which have been erected since the visitation last year, namely, the Thompson equatorial and the new altazimuth. The following extracts from the report contain a brief *résumé* of the year's work.

Buildings.

The building of the north wing and central dome of the Physical Observatory was finished in September 1896, with the exception of the vane on the central dome, which was completed last March.

An observing floor and gallery have quite recently been fitted up in the dome to facilitate work with the new Thompson equatorial, now mounted there. The completion of the Physical Observatory by the building of the east and west wings has been further delayed, though provision was made for commencing the work in the last financial year.

The Transit Circle.

With regard to this instrument, it has been found that the apparent correction for discordance between the nadir observations and stars observed by reflexion has been gradually increasing yearly, the difference for the present year being −0″·44, the greatest negative value recorded since 1888.

The increase in this discordance in 1896, following on the systematically negative values since 1891, led to a re-examination of the screws of the microscope-micrometers, of the screw of the telescope-micrometer, and of the errors of those divisions of the circle which are used in observations of the nadir, with a view to the discovery of the source of this discordance.

The microscope-micrometers showed signs of wear, but the reversal of three of the screws has successfully eliminated the effect of wear from the mean of the six microscopes.

The New Altazimuth.

This instrument was erected in May 1896, but it was not practicable to make observations with it till the completion of the observing floor in September. It was then found that there were serious discordances in the readings of the circles under the different microscopes, depending on the direction in which the instrument was last turned. Experiments indicated flexure in the axis, which has now been corrected by stiffening the axis by means of a strong diaphragm of special form fitted in the central part of the axis. The friction-rollers for taking the weight of the instrument have also been modified, the position being changed to bring them close to the pivots, and a system of levers has been substituted for springs. These changes reduced the discordances greatly in amount. Quite recently Mr. Simms has discovered a cause of error, arising from a tendency in the pivots to act as a screw, a longitudinal force being thus introduced, its direction depending on the direction in which the telescope is turned. This force had the effect of slightly moving the iron standards carrying the bearings and the microscopes, thus changing the position of the microscopes relatively to the graduated circles. This action of the pivots was found to arise from the method adopted in grinding them of giving a helical twist to the grinder, and it was cured by a few circular turns of the same tool.

The Thompson Equatorial.

This new instrument, presented by Sir Henry Thompson, forms a handsome addition to the Observatory, and it has been mounted in the Physical Observatory under the Lassell Dome. Its erection there was commenced early in November, but it was not ready for use till April, and there are still certain accessories which have to be supplied. The adjustment of the polar axis and of the 26-inch object-glass were at once taken in

hand, and the former was soon satisfactorily effected. For the adjustment of the object-glass a number of photographs have been taken inside and outside of the focus, the separation between the lenses being varied with a view to the correction of the small outstanding aberration and coma. Some photographs of the moon and of double stars have been taken, an enlarging camera with a Dallmeyer concave magnifier being applied to the telescope in some cases to give a magnified image. This equatorial carries not only the 26-inch photographic telescope with the 12¾-inch Merz guiding telescope and the Thompson 9-inch photoheliograph, but also a Cassegrain reflecting telescope of 30 inches aperture with the 6-inch Hodgson telescope as guider in place of the counterpoise at the other end of the declination axis. It thus provides a very powerful combination of telescopes specially adapted to photographic work of various kinds, and special arrangements in the instrument and observing room have been necessary to meet the varied requirements. The instrument has now been got into good working order, and is very satisfactory as regards the mechanical arrangements. The photographic spectroscope will be used in connection with the Cassegrain reflector mounted firmly at the back of the cell of the mirror, a diagonal prism being used to reflect the rays into the collimator.

The 28-inch Refractor.

This instrument was in constant use for micrometric measurements from 1896 May 11, to 1897 January 11. On January 12 the crown lens was reversed, and the instrument used for photography till April 23, except on the occasion of Prof. Barnard's visit to the Observatory, when the lens was replaced in the visual position. Besides several micrometric observations, 195 double stars were measured during the year ending May 10. The distance and position-angle of the satellite of Neptune were measured on four nights, and the equatorial and polar diameters on two nights. The equatorial and polar diameters of Mars were measured on seven nights. With the crown lens in the reversed position, a number of photographs was taken in and out of focus for the better adjustment of the separation of the lenses and the tilt.

The Astrophysical Equatorial.

The following statement shows the progress made with the photo-mapping of the heavens :—

	For the Chart (exposure 40m.).		For the Catalogue (exposures 6m., 3m. and 20s.).
Number of photographs taken	175	...	139
,, successful plates ...	135	...	110
,, fields photographed successfully...	133	...	98
Total number of successful fields reported 1896, May 10 ...	490	...	732
Number of photographs, previously considered successful, rejected during year ...	72	...	16
Total number of successful fields obtained to 1897 May 10 ...	351	...	814
Number still to be taken ...	598	...	335

Of the fields still required 197 are within 10° of the Pole, and no photographs of this part of the sky have yet been taken, the work being purposely deferred till near the epoch 1900.

Spectroscopic and Heliographic Observations.

Photographs of the sun were taken on 222 days, and of these 471 have been selected for preservation, besides twelve photographs with double images of the sun for determination of zero of position-angle.

For the preceding year Greenwich photographs were selected for measurement on 206 days, and photographs from the Solar Physics Committee (filling up the gaps in the series) on 154 days, making a total of 360 days out of 366 on which photographs are available.

The spot activity of the sun has continued on the whole to decline since the date of the last Report, but has undergone two remarkable cases of temporary revival; the one in September 1896, when the longest connected group ever photographed at Greenwich was observed, and the other at the commencement of the present year. On the other hand, the sun was seen to be free from spots on six days in the year ending 1897 May 10.

Magnetic Observations.

The variations of magnetic declination, horizontal force and vertical force, and of earth currents have been registered photographically, and acccompanying eye observations of absolute declination, horizontal force and dip have been made as in former years.

The principal results for the magnetic elements for 1896 are as follows :—

Mean declination ...	16° 56′·5 West.
Mean horizontal force	3·9834 (in British units). 1·8367 (in metric units).
Mean dip	67° 8′·5 (by 9-inch needles). 67° 9′·3 (by 6-inch needles). 67° 10′·0 (by 3-inch needles).

These results are to a certain extent affected by the iron in the new Physical Observatory, and in the new Altazimuth Pavilion.

The selection of the site for the new Magnetic Pavilion required much consideration and necessitated observations at a number of stations in Greenwich Park. As the result of the survey it was decided to abandon a site which had been provisionally selected at a distance of about 250 feet to the east of the reservoir, and to choose another at a considerably greater distance both from the reservoir and the Observatory.

Meteorological Observations.

The mean temperature of the year 1896 was 50°·1, being 0°·7 above the average for the fifty years 1841–1890.

During the twelve months ending 1897 April 30, the highest daily temperature in the shade recorded on the open stand was 91°·1 on July 14. The highest reading recorded in the Stevenson screen was 87°·6. Under the same conditions of exposure on the open stand there have been twenty-six instances of temperatures exceeding 90° recorded in the preceding fifty-five years, the highest having been 97°·1 on 1881 July 15. The temperature rose twice above 90° in 1896, and seventeen times above 80°. The monthly mean temperatures for June, July, February and March were respectively above the corresponding averages by 4°·0, 2°·8, 3°·5 and 3°·3; and the means for August, October, November and January were in defect by 2°·5, 3°·5, 2°·7 and 3°·1. The mean temperature for the twelve months 1896 May to 1897 April was 49°·7, being 0°·2 above the fifty years' average.

In the winter months of 1896–1897 there were forty-two days on which the temperature of the air fell to the freezing-point, or below; sixteen of these days occurring in January, and eleven in December. The lowest winter temperature was 23°·8 on 1897 January 18, as compared with 24°·3 in the preceding winter.

The number of hours of bright sunshine recorded during the twelve months ending 1897 April 30 by the Campbell-Stokes instrument (with the old ball up to December 31, and with the new ball after), was 1152 out of the 4454 hours during which the sun was above the horizon, so that the mean proportion of sunshine for the year was 0·259, constant sunshine being represented by 1. This amount is probably too small for reasons stated in the report.

The rainfall for the year ending 1897 April 30 was 26·83 inches, being 2·29 inches above the fifty years' average. The number of rainy days in the twelve months was 178.

Personal Establishment.

In the last Report mention was made regarding the reorganisation of the staff. The arrangement now adopted is that Mr. Dyson and Mr. Cowell have the general superintendence of all the work of the Observatory, Mr. Dyson taking special charge of the astronomical department, and Mr. Cowell of the astrophysical department, in which is included the magnetic and meteorological branch. Mr. Maunder is charged with the heliographic photography and reductions. Mr. Lewis has charge of the time-signals and chronometers, and of the 28-inch equatorial. Mr. Thackeray superintends the miscellaneous astronomical computations and meridian zenith-distance reductions. Mr. Hollis has charge of the photographic mapping of the heavens, the measurement of the plates, and the computations for the astrographic catalogue. Mr. Crommelin undertakes the altazimuth and Sheepshanks equatorial reductions, and Mr. Bryant the transit-reductions and time-determinations. In the magnetic and meteorological branch, Mr. Nash has the charge of the whole of the work.