

Cook, who was attached to the Belgian Antarctic Expedition, discourses pleasantly on "The Possibilities of Reaching the Four Poles." In *Good Words* Mr. E. W. Maunder writes on "The Lords of Cold" (the title, it may be noted, is borrowed from a line in Plumptre's "Dante"), the article being a study in stellar perspective. In the same magazine is also to be found a contribution, by Mr. Aflalo, on "How Wild Creatures Feed." *Chambers's Journal* always contains at least one article of scientific interest; the present number has in it papers, entitled "Tropical Diseases and Cures" and "Alcohol from Paper and Sawdust."

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. G. A. S. Bell, R.N.; a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Miss M. C. Rawcliffe; a Common Duiker (*Cephalophus grimmi*, ♂) from South Africa, presented by Mr. J. E. Matcham; five Wild Cats (*Felis catus*) from Inverness-shire, presented by Mr. George J. Bailey; a Levaillant's Amazon (*Chrysolis levaillanti*) from Mexico, presented by Mr. J. Farmer Hall; a Royal Python (*Python regius*) from West Africa, presented by Mr. Benjamin Stewart; an Alpine Newt (*Molge alpestris*), nine Black Salamanders (*Salamandra atra*), two Slowworms (*Anguis fragilis*) from Switzerland, presented by the Rev. J. W. Horsley; a Common Viper (*Vipera berus*), British, presented by Mr. G. Alan Marriott; a Common Duiker (*Cephalophus grimmi*, ♀) from South Africa, a Syrian Bear (*Ursus syriacus*) from Western Asia, a Cheetah (*Cynaelurus jubatus*) from India, two Black-faced Kangaroos (*Macropus melanops*, ♂, ♀) from Tasmania, six Wrinkled Terrapins (*Chrysemys scripta rugosa*) from the West Indies, an Amboina Box Tortoise (*Cyclemmys amboinensis*) from the East Indies, five Mississippi Terrapins (*Malacoclemmys geographica*), a Prickly Trionyx (*Trionyx spinifer*) from North America, three Annulated Terrapins (*Nicoria annulata*) from Western South America, deposited; a Three-toed Sloth (*Bradypus tridactylus*) from British Guiana, purchased.

OUR ASTRONOMICAL COLUMN.

EPIHEMERIS FOR OBSERVATIONS OF EROS.—The following computed positions for July are from the ephemeris prepared by Herr F. Ristenpart (*Astronomische Nachrichten*, Bd. 152, No. 3643).

Ephemeris for 12h. Berlin Mean Time.

1900.	R.A.	Decl.
h. m. s.	° ' "	° ' "
July 5 ... 0 54 6.51 ...	+14 13 22.3	
7 ... 57 27.78 ...	14 50 33.5	
9 ... 1 0 48.24 ...	15 27 55.3	
11 ... 4 7.89 ...	16 5 27.7	
13 ... 7 26.71 ...	16 43 10.8	
15 ... 10 44.66 ...	17 21 5.0	
17 ... 14 1.68 ...	17 59 10.8	
19 ... 17 17.70 ...	18 37 28.1	
21 ... 20 32.62 ...	19 15 57.1	
23 ... 23 46.36 ...	19 54 38.1	
25 ... 26 58.84 ...	20 33 31.3	
27 ... 30 9.98 ...	21 12 36.9	
29 ... 33 19.70 ...	21 51 55.1	
31 ... 1 36 27.93 ...	+22 31 26.5	

MEASURES OF EROS.—*Harvard College Observatory Circular* (No. 51) contains the results of the measurements of photographs obtained during the years 1893, 1894 and 1896, giving the positions of the planet during those years. The complete discussion of the measures is being prepared for a volume of the *Observatory Annals*, but the numbers here published show that at the Harvard College Observatory there is the means of tracing the path of any object since 1890, during the times in which it was moderately bright, with nearly as great accuracy as if a

series of observations had been taken of it with a meridian circle.

TOTAL ECLIPSE OF THE SUN, MAY 28.—M. Deslandres communicates the report of his work in connection with the recent eclipse to the *Comptes rendus* (vol. cxxx. pp. 1691-1695). His programme comprised four classes of investigation:—(1) velocity of corona; (2) ultra-violet spectrum of corona and chromosphere; (3) infra-red spectrum of corona; (4) photography of corona.

Observing visually with a powerful grating spectroscope, he found by the inclination of the corona line that on the west side of the equator the corona appeared to have a more rapid speed of rotation than the disc. The photographic spectra taken for this purpose are too faint for measurement.

The ultra-violet spectra were obtained with spar quartz prismatic cameras, ten plates being obtained showing good images down to λ 3000.

The investigation of the infra-red radiation from the corona was undertaken with a view of providing a possible means of observing the corona without an eclipse, and the results would indicate that the corona is specially rich in these calorific radiations. M. Deslandres states that at his station, Argamasilla, Spain, totality was five seconds shorter than the calculated time.

THE ROYAL OBSERVATORY, GREENWICH.

IT is customary for the Astronomer Royal to present his annual report to the Board of Visitors of the Royal Observatory on the first Saturday in June, but as it is easier to transfer such a function to another date than to change the time of a total eclipse of the sun, the usual day of meeting was adjourned until June 26 last. On this day, the weather, however, did not quite come up to summer standard; but fortunately the rain held off, and the afternoon proved sufficiently fine to allow the numerous visitors to inspect the buildings and instruments. As is customary, we give below a brief *résumé* of the report.

BUILDINGS.

The building of the new observatory so near to the boundary of the grounds has necessitated an alteration in the position of the old fence, to show the building off more effectively, so that provision has been made in the Navy estimates to put the fence further away, and the plans for this are now under consideration. This building also includes the new library rooms, and we learn that the removal of the books to their new position was completed in March last. The opportunity has also been utilised for their rearrangement and for the preparation of a new catalogue, both of which, we are told, were much needed. Not only is the rearrangement of the books practically complete, but good progress has also been made with the formation of the card catalogue, a system which is to be highly recommended.

TRANSIT CIRCLE.

The sun, moon, planets, and fundamental stars have been regularly observed on the meridian as in previous years. The number of observations made from 1899 May 11 to 1900 May 10, is as follows:—

Transits, the separate limbs being counted as one observation	10,712
Determinations of collimation error	297
Determinations of level error	684
Circle observations	10,001
Determinations of nadir point (included in the number of circle observations)	674
Reflexion observations of stars (similarly included)	637

The number of stars observed in 1899 is about 5000.

An unusually large number of observations was obtained in the three months, August-October, the average number of transits observed being more than 1300 each month. From November to the date of the report, in consequence of the cloudy weather, the average has been only half this number.

The apparent correction for discordance between the nadir observations and stars obtained by reflexion for 1899 was found to be slightly larger—namely, $-0''.41$ —than that of last year, which was $-0''.36$.

The results of recent years are as follows:—

	Mean	Range in Yearly Means
1880-1885	-0'34	From -0'29 to -0'45
1886-1891	+0'03	„ -0'12 to +0'09
1892-1898	-0'30	„ -0'25 to -0'36

Observations of level and nadir have been made, when practicable, three or more times on the same day, and diurnal changes similar to those referred to in the last report have been found in 1899. The observations of level taken within three hours of noon and midnight give corrections of +0'30 and +0'18 respectively, to those made within three hours of 6 p.m. Similarly the observations of nadir near noon and midnight give corrections of +0'17 to those made within three hours of 6 p.m.

In view of this systematic diurnal movement of the instrument and of the large number of observations of azimuth stars in recent years, it seems probable that the limit of accuracy obtainable by the use of double transits for the determination of the positions of the close polar stars has been reached, as this involves the assumption that the azimuth error remains constant for twelve hours at least. It has therefore been arranged to use these stars for determination of azimuth error, by means of their tabular right ascensions, and to keep the observations for improvement of the tabular place only when the azimuth error has been determined by at least three pairs of close polar stars above and below pole on the same evening.

The correction for the R-D discordance, found for 1899, is +0'080 + 0'218 sin Z.D. The coefficient of sin Z.D. was about +0'6 from 1881 to 1894, diminished to +0'41 and +0'37 in 1895 and 1896, to +0'10 in 1897 and 1898, and has now increased to +0'22.

The observations of the zenith distances of pairs of stars directly and by reflexion, alternately on alternate nights, have been discontinued. The observations made in the four years, 1895, 1896, 1897 and 1898, show a satisfactory agreement with the ordinary observations, reflexion and direct at the same transit, confirming the striking diminution in the value of the R-D discordance in 1897 and 1898 as compared with 1895 and 1896.

The colatitude of the transit circle, as found from observations of about 600 stars in 1899, is 38° 31' 21''·76, differing by -0'14 from the adopted value. The corresponding values of the correction to the adopted colatitude found in 1897 and 1898 are -0'17 and -0'15, and it may be noticed that the R-D discordance was very small in these years.

The mean error of the moon's tabular place (computed from Hansen's lunar tables with Newcomb's corrections) is -0'099 in R.A. and +0'27 in N.P.D., deduced from 116 observations. These are equivalent to an error of -1''·38 in longitude and 0'00 in ecliptic north polar distance.

The re-observation of the stars of Groombridge's Catalogue, which was the principal object of the Second Ten-Year Catalogue, furnishes material for determination of the proper motions of more than 4000 stars from observations about eighty years apart, with intermediate positions in the Radcliffe Catalogue of 1845. Provisional proper motions are given in the Introduction for 163 stars, for which the annual proper motion in R.A. or N.P.D. amounts to 0'1 of a great circle, and had not previously been determined. It is proposed to undertake the determination of the proper motions of all the stars in Groombridge's Catalogue. Before doing this it was considered desirable to re-examine Groombridge's Observations, with special reference to the determination of azimuth error, in view of the large systematic error in Right Ascension. The original MSS. of Groombridge's Observations have been kindly lent by the Council of the Royal Astronomical Society, and the examination is in progress.

THE NEW ALTAZIMUTH.

This instrument is now in good working order. Various repairs have been required and minor improvements have been made. The observations of transits seem quite satisfactory, the accordance in the results for clock error in different positions of the instrument (referred to the transit circle) being very good. For the zenith distance observations further determinations of flexure and division-errors are required, and these are in hand. The investigation of the division errors of both circles has shown that the accordance of two determinations is not very satisfactory, and the cause of the discrepancy is now under investigation.

Among the observations made with this instrument may be mentioned 1729 R.A. observations of the sun, planets and stars, 1418 N.P.D. observations, and 2386 observations for collimation, level, and azimuth errors, and nadir.

THE 28-INCH REFRACTOR.

This instrument has been used throughout the year for micro-metric measurements of double stars. 492 stars have been measured; 268 of these have their components less than 1''·0 apart, and 139 less than 0'5. The stars whose distance apart is less than 1''·0 have been measured on the average on three nights each, and the wider pairs on two nights. The wider pairs measured consist of bright stars with a faint companion, of third companions to close pairs, and of stars of special interest.

In consequence of Mr. Newall's suggestion that the newly discovered spectroscopic binary Capella might possibly be observed as a double star with large telescopes, it has been examined on fifteen nights (from April 4 to May 10) by a number of observers, who all found the star's image to be sensibly elongated; while the position angle of the elongation changed during the period of observation (April 4 to May 29) in fair accordance with the period of 104 days given by Mr. Newall.

THOMPSON EQUATORIAL.

THE 26-inch refractor has been in constant use throughout the year. The occulting shutter has been found of great value in obtaining accurately measurable photographs when one of the objects photographed is considerably brighter than the other objects in the field.

Fifteen photographs of Neptune and its satellite have been obtained, of which seven have been measured. Fifty-four photographs of twenty-six double stars have been obtained, of which forty-seven have been measured. Among these stars are Algor and Aldebaran, with their faint companions of fourteenth magnitude. The measures of distance and position-angle of the photographs of double stars are published in the *Monthly Notices of the Royal Astronomical Society* for April 1900. Nineteen photographs have been obtained of Comet Swift, of which fifteen have been measured, and the results published in the *Astronomische Nachrichten*, Nos. 3584-5. In addition, photographs of Polaris and neighbouring stars have been taken for parallax, a few photographs of the moon and some of the major planets with their satellites, and others for testing adjustments and the characters of the images in different parts of the field.

The 30-inch reflector has been used chiefly for the photography of nebulae and star clusters. The photographs of the nebulosity of the Pleiades and of the Orion nebula are very fine, and show a large amount of detail.

ASTROGRAPHIC EQUATORIAL.

The following statement shows the progress made with the plates for the chart and the catalogue respectively:—

	For the Chart (exposure 40m.)	For the Catalogue (exposures 6m., 3m., and 20s.)
Number of photographs taken ...	243	236
„ successful plates ...	162	181
„ fields photographed successfully ...	155	175
Total number of successful fields reported 1899 May 10 ...	1027	1030
Number of photographs, previously considered successful, rejected during the year ...	106	102
Total number of successful fields obtained to 1900 May 10 ...	1076	1103
Number still to be taken ...	73	46

A comparison of this list with the one published in the last report shows that great progress has been made in this work.

It is satisfactory to note that the plates are now placed in the new observatory, where they are kept dry and not subject to the extremes of temperature as formerly. Those that were previously spoilt through damp are now being gradually replaced.

During the year 88,000 measures of pairs of images (6m. and 3m.), as well as of the diameters of the 6m. images, have been made. The number of quarter plates measured in the twelve months in two positions of the plates is 556.

At the date of the last report the measurement of the plates was completed from December 64° to 69°; and in Zone 70° from R.A. oh. to 13h. 48m. During this year Zone 70° has been finished and Zones 71° and 72° have been measured, with the exception of thirty-six quarter plates. Subject to this exception, the measurement is complete from December 64° to 73°.

Good progress has been made with the printing of the measures. Zone 64° is finished and Zone 65° as far as R.A. 21h. 36m. It is estimated that all the measures from December 64° to December 72° will be included in one volume of about 650 pages.

HELIOGRAPHIC OBSERVATIONS.

In the year ending 1900 May 10, photographs of the sun have been taken on 180 days, either with the Thompson or Dallmeyer photo heliographs. The former, mounted on the Thompson 26-inch refractor, was used as the regular instrument for solar photography up to March 9, when it was temporarily dismantled, the Dallmeyer photo-heliograph being substituted for it. Of the photographs taken with either instrument, 369 have been selected for preservation, besides 11 photographs with double images of the sun, for determination of zero of position angle. Photographs to supplement the Greenwich series have been received from India or Mauritius up to 1900 March 8.

For the year 1899, Greenwich photographs have been selected for measurement on 202 days, and photographs from India and Mauritius (filling up gaps in the series) on 162 days, making a total of 364 days out of 365 on which photographs are at present available.

The chief characteristic of the sun's surface, during the period covered by this report, has been the steady decline in the mean daily number and area of spots observed, August and September 1899 in particular showing a marked sub-minimum.

MAGNETIC OBSERVATIONS.

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

The regular observations of magnetic declination have been made since 1899 January 1, in the Magnetic Pavilion, alternating with determinations in the Magnet House (for effect of the iron in the Observatory buildings), the observations in the Magnetic Pavilion being made with a hollow cylindrical magnet mounted in conjunction with the large theodolite.

The determinations of horizontal force and dip have been made with the Gibson deflexion instrument and the Airy dip circle mounted in the new Magnetic Pavilion, since 1898 September.

The principal results for the magnetic elements for 1899 are as follows :-

Mean declination	16° 34' 2 West.
Mean horizontal force	{	3'9947 (in British units).	
	{	1'8419 (in Metric units).	
Mean dip (with 3-inch needles)	67° 10' 13".

These results depend on observations made in the new Magnetic Pavilion, and are free from any disturbing effect of iron. The correction to the declination, as found in the Magnet House, is - 10' 7, as deduced from the observations made with the new declinometer in the Magnetic Pavilion.

The magnetic disturbances in 1899 have been few in number. There were no days of great magnetic disturbance and sixteen of lesser disturbance. Tracings of the photographic curves for these days, selected in concert with M. Mascart, will be published in the annual volume as usual. The calculation of diurnal inequalities from five typical quiet days in each month has been continued.

The question of the regulations to be enforced for the protection of the Observatory from disturbance of the magnetic registers by electric railways or tramways in the neighbourhood is now under the consideration of the Board of Trade.

METEOROLOGICAL OBSERVATIONS.

Consequent on the changes in connection with the new Observatory buildings, the shed containing the photographic thermometers was moved 15 feet towards the west on May 16 and 17, 1899.

The Kew Committee of the Royal Society has suggested that

steps should be taken to assimilate the methods of registration of atmospheric electricity with the Thomson electrometers at Greenwich and Kew, and the question of the modifications to be introduced into the Greenwich electrometer is now under consideration.

The mean temperature for the year 1899 was 50° 7, being 1° 2 above the average for the fifty years, 1841-90.

During the twelve months ending 1900 April 30, the highest temperature in the shade (recorded on the open stand in the Magnetic Pavilion enclosure) was 90° 0, on August 15. The highest temperature recorded in the Stevenson screen in the Observatory grounds was 88° 8 on the same day.

The month of August was exceptionally warm, the mean temperature for the month being 65° 5, which is 3° 9 above the fifty years' average (1841-1890). This high temperature for the month has only been reached before on one occasion in the previous fifty-eight years, viz. in August 1857. The month of November was also exceptionally warm, the mean temperature for the month being 4° 8 above the average.

The lowest temperature of the air recorded in the year was 18° 0, on February 9. There were fifty days during the winter on which the temperature fell below 32°, a number slightly below the average.

The mean daily horizontal movement of the air in the twelve months ending 1900 April 30 was 268 miles, which is 13 miles below the average for the preceding thirty-two years. The greatest recorded daily movement was 776 miles on April 13, and the least 50 miles on October 22. The greatest recorded pressure of the wind was 27 lbs. on the square foot, on November 3, and the greatest hourly velocity 48 miles, on April 13.

The number of hours of bright sunshine recorded during the twelve months ending 1900 April 30, by the Campbell-Stokes instrument, was 1636 out of the 4454 hours during which the sun was above the horizon, so that the mean proportion of sunshine for the year was 0 367, constant sunshine being represented by 1.

The rainfall for the year ending 1900 April 30 was 21 97 inches, being 2 57 inches less than the average of fifty years. The number of rainy days was 146. The rainfall in the month of August was only 0 354 inch, being the smallest August rainfall on record in the fifty-nine years, 1841-99. The next smallest value was 0 45 inch, in August 1849. The rainfall in February amounted to 3 58 inches, being the largest February rainfall on record in the sixty years, 1841-1900, with the exception of the February rainfalls in 1866 and 1879, which amounted to 4 03 and 3 81 inches respectively.

The remaining portion of the report is devoted to the progress in the printing and distribution of the publications and chronometers, time-signals, longitude operations, &c.

In view of the large additions to and modifications in the instruments and buildings of the Royal Observatory in recent years, it is proposed to prepare a full description of the Observatory, illustrated by photographs.

It may be mentioned that the Observatory equipped and sent out an expedition to observe the total solar eclipse of May 28, having received the sanction of the Admiralty. The Astronomer Royal, with Mr. Dyson and Mr. Davidson, left for Ovar, in Portugal, on May 11, taking with them the Thompson 9-inch photographic telescope, the new 4-inch enlarging lens for large-scale photographs of the corona, a pair of photographic spectroscopes with heliostat, lent by Captain Hills, for photographing the spectrum of the lower chromosphere and of the corona, and a double camera, on one of the photo-heliograph mountings, with lenses of 4 inches and 2 1/2 inches aperture for photographing the coronal streamers.

An examination of the fine photographs that were obtained by the party, which were shown on the day of the visitation, gave one a good idea of the success which had rewarded their efforts.

THE GEOLOGICAL AGE OF THE EARTH.¹

WHILE, in his efforts to arrive at an estimate of geological time, the geologist himself is seriously hampered by the uncertainty of the data at his disposal, he has followed with expectant interest the successive attempts made by votaries of

¹ "An Estimate of the Geological Age of the Earth." By J. Joly, M.A., D.Sc., F.R.S., Hon. Sec. Royal Dublin Society; Professor of Geology and Mineralogy in the University of Dublin. Pp. 44. (*Scientific Transactions of the Royal Dublin Society*, vol. vii. Ser. ii. Dublin, 1899.)