THE additions to the Zoological Society's Gardens during the past week include a Servaline Cat (*Felis servalina*), a Serval (*Felis serval*) from Uganda, presented by Mr. Francis G. Hall; a Greater Sulphur-crested Cockatoo (*Cacutua galerita*) from Australia, presented by Mr. P. G. Dupuch; two Golden Eagles (*Aquila chrysætus*), European, presented by Edgar Baxter; a Yellow-billed Sheathbill (*Chionis alba*), captured at sea, presented by Captain H. W. Schlemann; a Bean Goose (*Anser secetum*), European, presented by Mr. W. H. St. Quintin; two Egyptian Kites (*Milvus ægyptius*) from Congoland, presented by the Rev. R. H. C. Graham; a Common Viper (*Vipera berus*) from Cornwall, presented by the Rev. John Harris; a Burchell's Zebra (*Equus burchelli*, δ) from South Africa, deposited; two Black Hornbills (*Lophoceros nasutus*) from West Africa, a Yarrell's Curassow (*Crax carunculata*) from South-east Brazil, a Guan Ortalida from South America, a Double-ringed Turtle Dove (*Turtur bitorquatus*) from Java, purchased; an English Bull (*Bos taurus*) born in the Gardens.

Erratum.—In the classification of Bacteria given in the review of Prof. Migula's work on "Systematic Bacteriology," which appeared in last week's NATURE, the term "genus" should be substituted for "species."

OUR ASTRONOMICAL COLUMN.

THE COMPANION TO PROCYON.—As is well known Prof. Schaeberle discovered in November 1896 a companion to Procyon, which he suggested would prove the theoretical companion predicted by Bessel. This difficult object—difficult on account of its nearness to Procyon, not by reason of its faintness—has been satisfactorily observed at the Yerkes Observatory, thus confirming Prof. Schaeberle's measures, the motion of the object, and its suggested identity with Bessel's companion. We have now the following measures:

1896, November	...	P = 318·8	...	D = 4″·59
1897, October	...	P = 324·1	...	D = 4·70
1898, March	...	P = 326·0	...	D = 4·83

Prof. Barnard, who reports the observation, says that when the seeing is good, the companion star is a very conspicuous object and easy to measure with the bright star in the field unobscured. It was estimated to be one magnitude fainter than the old companion, which is of about the twelfth magnitude. This description, however, scarcely agrees with that of Prof. Schaeberle, who states that he made a measure of the star in November 1897, ten minutes before sunrise, and when looking along the outside of the telescope Procyon was no longer visible in the sky. This would imply that the comes was brighter than the thirteenth magnitude, and therefore more observations may be anticipated.

THE LIVERPOOL OBSERVATORY.—We have received the annual report of the director of the Liverpool Observatory, and are glad to see that he is making some attempt to break away from the mere meteorological observations, which have so long held sway at this observatory. The present attempt is a very small one, consisting merely in the observation of the Right Ascension of some of the circumpolar stars that Prof. Auwers has suggested should be continuously observed, with the view of affording more frequent opportunities, and more accurate determinations of the azimuthal error of transit instruments. Cometary observations have always formed a part of the routine work of this observatory, since the appointment of the present director. These are still being actively prosecuted, when the brightness of the comet permits. We notice also that the observatory is taking some part in the inquiries that are now going on in seismometry and the physics of the earth's crust.

SUNSPOT PERIODS AND NATURAL PHENOMENA.—In an article entitled "Le Soleil et la Nature" in the *Bulletin de la Société Astronomique de France* for June, M. Camille Flammarion brings together some very interesting data concerning the connection between the sunspot period and the yearly return of swallows, cuckoos and nightingales, and the flowering of chestnuts and lilacs. The observations have been extended over several years. In the case of the chestnuts and lilacs, M. Flammarion himself commenced the series in the year 1871, and not only observed the same trees every year when they began to bud, but employed the same scale of observation from the first; the observations are thus homogeneous throughout. In the remarkable series of figures accompanying the article, M. Flammarion has grouped together the observations of three years, and plotted curves which undoubtedly suggest a connection between one another, and with that representing the number of spots on the sun. Further, when spots are most numerous migratory birds return to any one place earlier in the year than usual, and when spots are at a minimum they do not come back until a much later date. In the case of swallows this is very remarkable, as observations of their time of return have been made since 1853, a period of forty-five years. The curve has a period of about eleven years, and the times of the maxima and minima correspond well with those of the sunspot curve.

Another curious fact M. Flammarion points out is that the curves showing the temperature of the months of March and April and the mean temperature of the year are nearly identical for the period covered by the years 1876-97.

DOUBLE AND MULTIPLE SOUTHERN STARS.—On April 28 of this year we noted in this column that Dr. T. J. J. See had published in the *Astronomical Journal*, Nos. 431-432, some details of his plan of double and multiple southern stars, and the first part of a catalogue of new double stars. In the current numbers of the *Astro. Nachr.* (Nos. 3495-6) he publishes a further catalogue containing the measures of those systems made at the Lowell Observatory during the past year and four months. In many instances these measures are the first that have ever been made, and on that account a great part of the accompanying results possess a degree of interest equal to that of the first measures of new double stars. Messrs. W. A. Cogshall and S. L. Boothroyd have ably assisted Dr. See in this work.

THE ROYAL OBSERVATORY, GREENWICH.

ON Saturday last (June 4) the Astronomer Royal presented his annual report to the Board of Visitors of the Royal Observatory, Greenwich. As usual the numerous guests numbered among them many astronomers and other men of science; and the weather, though at times threatening, proved sufficiently fine to allow the buildings and instruments to be comfortably inspected. The following brief *résumé* is taken from the report:—

Buildings.

The buildings on the south side of the grounds, which form part of the new physical observatory, are now approaching completion, having been delayed somewhat by a failure in the supply of terra-cotta. Up to the present time the construction of the magnetic pavilion has not been commenced, although provision has been made for it and a good site selected. It is hoped that this will no longer be delayed, for the amount of iron recently used in the construction of the new physical observatory has a very decided effect on all the magnetic instruments in the old buildings. For some months past we have noticed a scaffolding outside the dome of the 28-inch. This we read was put up in February last in preparation for erecting a balcony round the building, but the plans were subsequently reconsidered and modified, and the work in consequence delayed. The electric light and telephone communication has been extended to the new buildings, and a new accumulator house is being constructed in the basement on the north-east side of the physical observatory to replace the shed in which they are now located.

Transit Circle.

A diagram on the wall of the transit room showed a curve which had been plotted, the points in the curve representing the number of R.A. observations and circle readings for each year from 1877. A glance at this curve showed that the number of transit observations during the more recent years has increased by leaps and bounds, and where in place of the usual 4000 observations per year in 1877-80, the number now has reached the figure 11,000. This year the transits, counting separate limbs as one observation, amount to 11,441, excluding determinations of collimation error 297 and level error 651. The circle readings were 10,626. The correction for the R.D. discordance

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for 1897 has been found to be very small, amounting to +0″·068 + 0′·104 sin L.D. The colatitude of the transit circle obtained from 800 stars in 1897 was 38° 31′ 21″·69, differing by −0″·21 from the adopted value.

The mean error of the moon's tabular place (computed from Hansen's lunar tables with Newcomb's corrections) is −0ˢ·142 in R.A. and +0″·27 in N.P.D. deduced from 95 observations. These are equivalent to an error of −1″·97 in longitude and +0″·16 in ecliptic north polar distance.

The New Altazimuth.

The axis of this instrument has been considerably stiffened, and modifications in the friction rollers have been made to relieve the weight of the instrument on its bearings. Changes have also been made in the illumination of the field and microscopes. In December last the instrument was brought into working order; but regular observations have only recently been commenced, as the determination of division errors, and other observations necessary to test the stability of the instrument, occupied several months' work.

The observations on the whole show satisfactory stability in the instrument, the collimation, level, and azimuth being steady. Long series of observations of the nadir point have been made to test the stability of the microscopes and of the instrument generally for zenith distance observations. Discordances were found in the results given by the two circles, which, after a considerable time had been spent, were traced to the wheel carrying one of the sets of microscopes, which was found to have worked loose. This was remedied recently, and the accordance in the results from the two circles appears now to be satisfactory. But large changes in the readings of the individual microscopes are found on turning the instrument into different azimuths, which, however, would not affect the observations, as the microscopes come back to sensibly the same readings for the same azimuth. As, however, this implies a displacement of the microscopes relatively to the circles when the instrument is turned, Mr. Simms is considering whether the supports of the microscopes and pivots can be stiffened.

Thompson Equatorial.

Photographic tests with the 26-inch object-glass, varying the distance between the two lenses, show that the images were never good when away from the centre of the field. The glasses were, therefore, sent back to Sir Howard Grubb for alteration, and have only just been returned. A few trial photographs show that the "coma" is now corrected, but that a slight refiguring is still required. This, we are told, is being now done by Sir Howard Grubb at the observatory.

The 30-inch Cassegrain, mounted on the other end of the declination axis, has been employed for obtaining photographs of the moon, star clusters, and star fields. These have all been obtained at the secondary focus, the focal length of the mirror being somewhat longer than that for which the tube was designed, making it impracticable to take photographs with it at the primary focus. Dr. Common proposes to supply another mirror of the correct focal length, 11 feet 3 inches.

The photographic spectroscope has been completed, and is mounted at the back of the cell of the 30-inch mirror, but the diagonal prism to reflect the rays from the Cassegrain telescope into the collimator has not yet been mounted and adjusted.

The 28-inch Refractor.

This instrument was in use for micrometric measurements from 1897 May 11 to 1898 May 10, with the exception of about seven weeks, from August 5 to September 23, when it was used for photography, the crown lens being reversed. During the year 273 double stars have been measured, each star being measured on the average on two nights; the distance between the components of these stars is less than 1″·0 in 156 cases, and in 63 less than 0″·5.

From August 5 to September 25, 1897, the instrument was used with the crown lens in the photographic position. During this period 110 measurable images of 17 double stars were obtained on dry collodion plates. The closest of these pairs were:—

	Magnitudes.	Distance.
Σ 2881	7·7 and 8·2	1″·6
Σ 2723	6·4 ,, 8·2	1·5
Σ 2900	6·0 ,, 9·2	1·5
Σ 2799	6·6 ,, 6·6	1·3

Astrographic 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	363	147
,, successful plates	285	118
,, field photographed successfully	283	110
Total number of successful fields reported 1897 May 10	551	814
Number of photographs, previously considered successful, rejected during the year ...	6	15
Total number of successful fields obtained to 1898 May 10 ...	828	909
Number still to be taken ...	321	240

An important but unsatisfactory discovery has been made by an examination of all the plates on the shelves. This has shown that 166 catalogue plates out of 909—that is, nearly one-fifth of the total number—and 90 chart plates out of 828 have deteriorated owing, probably, to the effect of damp in the building in which they have to be stored pending the completion of the new physical observatory. There is difficulty in warming this building adequately, and the books, as well as the photographs stored there, have suffered from damp. The film has, in some cases, left the glass, and in the others shows signs of doing so. Of the 166 damaged catalogue plates, 57 have been completely measured, 23 partially measured, and 86 are not measured.

The importance of making duplicates as soon as possible of all negatives in such a work as this cannot be underrated. Positives on glass of all the 90 damaged chart plates were taken, and these are uninjured.

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. It is proposed to begin taking these now, and the settings of the scales for the guiding stars are partly computed.

Spectroscopic and Heliographic Observations.

No spectroscopic observations have been made during the last twelve months.

With the Dallmeyer photo-heliograph photographs of the sun have been secured on 191 days, 355 of these being selected for preservation, besides nine photographs with double images of the sun for the determination of zero of position. With the Thompson 9-inch photo-heliograph twenty-two photographs were taken on twelve days. Photographs to supplement the Greenwich series have been received from India and Mauritius up to 1898 February 22.

For the year 1897 Greenwich photographs have been selected for measurement on 183 days, and photographs from India and Mauritius (filling up the gaps in the series) on 181 days, making a total of 364 days out of 365 on which photographs are available. The importance of utilising the clear sky of India and Mauritius for obtaining the photographs can hardly be better demonstrated than by the figures given above, which show that on only one day out of the whole year a photograph record of the sun's disc was not secured.

There has been but little change in the mean daily spotted area of the sun for the period covered by the report as compared with the preceding one. The progress towards minimum has shown itself rather in the increase of days when the sun was wholly free from spots, than in the poverty of the displays of spots on the days when the sun's surface was disturbed.

It will be remembered that about the time of the recent eclipse in January there were several, comparatively speaking, large spots on the solar disc, considering that the minimum period was so near at hand.

The remark made regarding the deterioration of the astrographic plates applies also to many of the solar photographs, an examination having shown that some of those stored in the new library and in the museum of the physical observatory, both gelatine and wet collodion, have suffered from damp, spots of mildew being found on the film, though much more frequently the mildew is confined to the uncoated side of the glass.

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Magnetic Observations.

Fortunately for the magnetic records secured at the observatory, the proposed electric tram-line in the neighbourhood of the Deptford Cattle Market has been successfully opposed. That this would have seriously damaged the records there can be absolutely no doubt, since it would have been only 1¼ miles from the observatory: even now small agitations, due to the running of trains on the South London Electric Railway, 4½ miles from the observatory, can be clearly traced from the year 1890 on the horizontal and vertical force sheets, synchronising with the disturbances in the earth current registers.

The principal results for the magnetic elements for 1897 are as follows:—

Mean declination	16° 50′·4 West.
Mean horizontal force by the Gibson instrument in the library ...	3·9877 (in British units). 1·8387 (in metric units).
Mean dip	67° 5′·5 (by 9-inch needles). 67° 6′·8 (by 6-inch needles). 67° 7′·1 (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. To eliminate this effect as far as circumstances would allow, observations have been made during the past year on the site selected for the new magnetic pavilion in Greenwich Park, which is presumably free from any disturbing effect of iron. The horizontal force has been observed monthly on this site with the two deflection instruments (Gibson and Elliott), the declination occasionally with the Elliott instrument, and a dip with a Kew dip circle (Dover 74).

It appears from these observations that the declination at the observatory has been increased by 3′ to 4′ through the introduction of iron.

The mean horizontal force obtained with the Gibson instrument in the park is 1·8366 in metric units. In the same units we have also the following differences:—

Gibson in library—Gibson in park ...	+ 0·0021
Elliott in library—Elliott in park	+ 0·0084
Elliott in its usual position in library—Elliott on Gibson pier	+ 0·0060
Gibson in park—Elliott in park	+ 0·0010

All the magnetic disturbances during 1897 were of a comparatively trifling nature.

Meteorological Observations.

The mean temperature of the year 1897 was 50°·3, being 0°·9 above the average for the fifty years 1841–1890.

During the twelve months ending 1898 April 30, the highest daily temperature in the shade recorded on the open stand was 90°·2 on June 24. The highest reading recorded in the Stevenson screen was 87°·4 on the same day. The monthly mean temperatures were in excess of their corresponding averages in every month with the exception of May, September, and March. In January the excess amounted to 5°, the mean temperature for that month being 43°·6. In the preceding fifty-seven years there is one instance only of a higher mean temperature occurring in January, viz. in 1884, when it was 43°·9. A mean value equal to the present January value (43°·6) was also recorded in two other years (1875 and 1890). The winter of 1897–1898 was remarkably mild throughout, and the temperature of the air fell to freezing point (or below) on twenty-nine days only—ten of these occurring in March and seven in December. The lowest temperature recorded during the winter was 23°·3 on December 24. [The lowest temperature recorded in January was 30°·0.] The mean temperature for the five months 1897 October to 1898 February, was 44°·6, being 2°·4 in excess of the average value. During the whole period of fifty-seven years (1841 to 1897) this value has only been exceeded three times, viz. in the winter of 1876-1877, when the mean for the five months was 45°·8, in the winter of 1845–1846, when it was 44°·8, and in the winter of 1865–1866, when it was 44°·7. A mean value of 44°·6 (the same as that for the present year) was also recorded in the winter of 1848-1849, and in that of 1868-1869.

The number of hours of bright sunshine recorded during the twelve months ending 1898 April 30, by the Campbell-Stokes instrument, was 1529 out of the 4454 hours during which the sun was above the horizon, so that the mean proportion of sunshine for the year was 0·343, constant sunshine being represented by 1.

An interesting comparison is made between the results as given by the new and the old ball of the sunshine recorder for 1897. With the former 1542·6 hours were registered throughout the year, while with the latter only 1268·4 hours, the excess with the new ball amounting to 274·2 hours during the twelve months.

The rainfall for the year ending 1898 April 30 was 17·33 inches, being 7·21 inches less than the fifty years' average. The number of rainy days was only 149. This is a very small annual rainfall; the three smallest falls during the preceding fifty years being 16·38 inches in 1864, 17·61 inches in 1867, and 17·70 inches in 1858.

Personnel.

No change of any importance has been made with regard to the staff during the past twelve months, Mr. Dyson continuing to take special charge of the astronomical department, and Mr. Cowell the astro-physical department, in which is included the magnetic and meteorological branch.

GUTTA PERCHA.

IN a recent course of three lectures[1] delivered before the Society of Arts, and subsequently revised and reprinted from the *Journal* of the Society, with additional illustrations and appendices in the form of a bulky pamphlet, Dr. Obach dealt very fully with the history, origin, treatment and properties of gutta percha.

In the first lecture the early history, botanical derivation and geographical distribution of this substance were related, and the analyses of various commercial "brands," as well as exhaustive statistics of the annual imports and exports of the material were given.

In the second lecture the mechanical cleaning processes and chemical washing and hardening processes were described and illustrated, and also the different methods of extraction of gutta percha from removable parts of the trees, such as twigs and leaves, explained. This lecture concluded with an enumeration of the various *natural* substitutes for gutta percha which have been proposed at various times, including the interesting material known as *balata*.

The third lecture dealt with the mechanical and electrical properties of gutta percha and its application for various technical purposes, also its behaviour towards water, oxygen and ozone. In conclusion the *artificial* substitutes for gutta percha were briefly discussed.

The following is a short report on those parts of the third lecture which we think may be more especially interesting to the readers of NATURE.

In order to simplify matters, Dr. Obach selected from the numerous sorts of gutta percha which make their appearance on the Singapore market twelve different "brands," which may be considered as typical; they are distinguished by the name of the locality whence they are derived. For direct comparison and easy reference these twelve materials were divided into four groups, each group comprising materials more particularly related to each other. The groups were designated as "Genuine," "Soondie," "White," and "Mixed."

It was explained that cleaned gutta percha consists essentially of two constituents, viz. a hydrocarbon termed pure gutta (G) having the composition $C_{10}H_{16}$, and being therefore isomeric with oil of turpentine, and a resin (R) containing more or less oxygen, and consisting principally of two substances named Albane $C_{10}H_{16}O$, and Fluavile $C_{20}H_{32}O$. Besides these proximate components there is also a variable amount of extraneous matter present in every commercial gutta percha, even after the most scrupulous cleaning, which consists of finely-ground bark, wood fibres, vegetable colouring matter, grit, &c., summarily termed dirt (D), and of water (W).

Dr. Obach has found that the physical and mechanical properties of the various sorts of gutta percha depend almost exclusively on the relative proportion of gutta and resin, *i.e.* the ratio $\frac{G}{R}$, whereas the electrical properties depend chiefly on the nature of the gutta and, to a lesser extent, upon that of the

[1] "Cantor Lectures on Gutta Percha," by Dr. Eugene F. A. Obach, F.I.C., F.C.S., M.I.E.E.

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