Little Cormorant (*Phalacrocorax javanicus*), a Green-winged Dove (*Chalcophaps indica*) from India, received in exchange; a Japanese Deer (*Cervus sika*), five Rosy-billed Ducks (*Metopiana peposaca*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

VELOCITIES OF METEORS.—At the second annual meeting of the Astronomical and Astrophysical Society of America, recently held at Columbia University, New York, Dr. W. L. Elkin described the apparatus and results of photographs obtained at the Yale Observatory for the determination of the velocity of meteors (*Science*, vol. xii. pp. 125-6). The idea of using photography for this purpose appears to have been first suggested by J. H. Lane in 1860, but it was not until 1885 that Zenker made the next practical attempt in Berlin, and attention has again been recently called to the matter by Prof. Fitzgerald. The Yale apparatus consists of a bicycle wheel fitted with twelve radial opaque screens, fixed so that, while rotating, the screens are brought intermittently in front of the cameras. The wheel as at present worked makes about 50-60 revolutions per minute, but it would be better to increase this speed in future apparatus. A check on the velocity is afforded by records made each revolution on a chronograph. The length of interruption of the meteor trail and the consequent velocity are then determinable if a second observation of the meteor from a distant station has been obtained. In November and December 1899, five such duplicate trails were secured. The apparent velocities of these are given as 50·4, 12·2, 50·3, 20·2, 36·5 kilometres per sec.; their altitudes varying from 45 to 100 kilometres. Correcting the apparent velocities for the attraction of the earth and the diurnal rotation by Schiaparelli's formulæ, the true velocities with respect to the sun are 34·4, 32·0, 32·4, 39·8, 34·0 kilometres per sec.

Comparing these velocities with those calculated on assumption of parabolic or elliptic orbits, the real velocities are in all cases smaller, indicating that the atmospheric retardation has amounted to 8-15 kilometres per sec. The elements deduced for one meteor, an Andromedid, agree remarkably closely with those of Biela's comet, showing the method to be capable of considerable accuracy.

STANDARDS FOR FAINT STELLAR MAGNITUDES.—Prof. E. C. Pickering announced at the above-mentioned conference that a grant of 500 dollars had been made from the Romford Fund for the purpose of carrying out an investigation on the brightness of faint stars by the co-operation of several observatories possessing large telescopes. The point immediately desirable is the accurate measurement of a few stars which shall serve as standards for future work on a larger scale. Five photometers have been constructed, each having a photographic wedge which may be interposed between the eye and the star as seen by the telescope. Thirty-six regions have been carefully selected in different parts of the sky, and twenty stars (five of each of magnitudes 12, 15, 16, 17) are to be chosen in each region, the faintest to be selected and measured with the Lick and Yerkes telescopes. The stars of the 16th magnitude will be measured with the 26-inch of the University of Virginia, and perhaps also with the 23-inch Princeton refractor; those of the 15th magnitude will be measured by the 15-inch Harvard telescope. All of these are to be then compared with stars of the 12th magnitude, whose *absolute* magnitudes will finally be determined with the 12-inch Harvard meridian photometer. After the work is properly got in hand, it is hoped that it may be reduced to a simple routine without sacrificing the quality of the results.

THE TOTAL SOLAR ECLIPSE, MAY 28, 1900.—As more detailed reports of the results obtained by the American observers during the recent total eclipse come to hand, it is interesting to note the increased use which has been made of large diffraction gratings, both concave and plane. In *Science* (vol. xii. pp. 174-184), Mr. L. E. Jewell describes the work at Pinehurst, N.C., and Griffin, Georgia, of the two parties organised by the physical department of the Johns Hopkins University. At each station there were installed two spectroscopes, one having a plane diffraction grating, surface 3 × 5 inches, 15,000 lines to the inch, used in conjunction with a quartz lens to photograph the spectrum of the first order; the other having a concave grating of 10 feet radius and 15,000 lines to the inch, mounted in the usual Rowland form, with a large quartz lens to throw an image of the sun on the slit-plate from a heliostat. The photographs were very successful, and show the spectrum from wave-lengths 3000 to 6000, even the exposures of only one second giving good negatives.

In the same number of *Science* Profs. E. B. Frost and E. E. Barnard describe the apparatus they successfully used during the same eclipse at Wadesboro, N.C.

REPORT OF THE CAPE OBSERVATORY.—In his report for the year 1899 Sir David Gill, Her Majesty's Astronomer at the Cape of Good Hope Observatory, makes special mention of the completion of the new record room, providing storage for manuscripts, the safe preservation and orderly arrangement of the precious astrographic plates, and also serving as the place where the measurements of these plates are undertaken.

The pier and foundations for the new transit circle are completed, but the delay in obtaining the sheet steel dome has kept the work at a standstill. The observations with the transit instrument have been mainly those of the standard stars for the reduction of the Catalogue Astrographic plates. When the new transit circle arrives it will be entirely devoted to the systematic meridian observations of the sun, Mercury, Venus and fundamental stars. With the heliometer, observations of all the oppositions of major planets have been continued.

The 24-inch object glass of the McClean equatorial was returned to Sir Howard Grubb for refiguring, and this instrument has hitherto only been used with a slit spectroscope for stellar spectra. Since the photographic objective was dismounted the 18-inch visual lens has been used for measurements of twenty-one close double stars. The 7-inch equatorial has been used in the revision of the Cape Photographic Durchmusterung, in the observation of suspected variable stars, and in the detection of double stars.

The 6-inch instrument with a Zollner photometer has been used for determining the visual magnitudes of stars in selected areas of different galactic latitudes, the photographic magnitudes of which are already determined. A comparison between the visual and photographic magnitudes will subsequently be made. With the astrographic equatorial 152 *chart* plates and 184 *revision catalogue* plates have been passed. 103 plates, containing 38,785 stars, have been measured during the year, all observations showing an error of 0″·6 being repeated.

Seventy-eight photographs of *Iris* were taken during the period July 11–December 31, with *six* exposures on each plate. In conjunction with meridian observations of comparison stars, it is intended to use the results of the measurements of these plates for determining the mass of the moon.

The geodetic survey of South Africa and Rhodesia has been considerably advanced, but was interrupted by the outbreak of the Transvaal war. The Anglo-German boundary survey has been hindered by the waterless character of the Kalihari Desert, but the work is now completed as far as Arahoab, from which an offset chain will be carried to the 20th meridian.

ROUSDON OBSERVATORY (DEVON).—Sir C. E. Peek sends a pamphlet of sixteen pages containing the sixth contribution of systematic observations of variable stars made at his observatory at Rousdon, Lyme Regis, Devonshire. The present report furnishes the details of the variability of T Cassiopeiæ for the ten years 1889–1898, and of R Cassiopeiæ for the twelve years 1887–1898. The light curves of both stars are also plotted at the end of the pamphlet.

INDEPENDENT DAY NUMBERS FOR 1902.—A small pamphlet has been issued from the Cape Observatory giving the independent day numbers for correcting the places of stars given in the *Nautical Almanac* for 1902. The values of the constants of precession, aberration and nutation employed in these tables are those recommended by the Paris International Conference of 1896.

THE AUGUST PERSEIDS OF 1900.

OBSERVATIONS of this well-known annual display were much hindered by moonlight, though the weather was generally clear at about the time of the maximum. Our satellite was full on the evening of August 10, and obscured all the smaller meteors. Apart, however, from this interference, the shower of 1900 seems to have been a somewhat scanty one. It furnished a considerable number of large

meteors it is true, and of these it is hoped the real paths may be computed; but on the nights of August 10 and 11 observers were somewhat disappointed with the character of their results. The effect of the full moon's influence in practically obliterating a meteoric shower may not, however, have been given sufficient weight. The best night appears to have been August 12, when shooting stars were tolerably frequent considering the circumstances.

But if moonlight presented an obstacle to success in the second week of August, there was no such impediment early in the month and during the last fortnight of July. The earlier stages of the shower were therefore well observed. In fact, it is questionable whether the Perseids have ever been more successfully observed in the month of July. Among those who participated in the observations were Prof. A. S. Herschel, Messrs. J. R. Bridger, W. E. Besley, A. King, and many others. At Cambridge a large number of meteors were recorded. The results show that the first Perseids were noticed on about July 16, and gradually increased in numbers until the date of maximum. The radiant showed the usual E.N.E. motion in a most decided manner.

At Bristol, between July 15–30, in 17¼ hours of observation, 177 meteors were seen, including about 24 Aquarids (radiant 338° − 10°) and 20 Perseids. But the only night on which a sufficient number of Perseids were registered to indicate a good radiant was July 30, when the position was at 31° + 54° from 10 paths. Several of the most prominent of the minor showers of the epoch were observed, and their radiants accurately determined as follows:—

24° + 43°, 7 meteors	305° − 12°, 8 meteors
291° + 59°, 6 ,,	315° + 47°, 9 ,,
292° + 52°, 7 ,,	335° + 73°, 5 ,,

Other showers were indicated at 53° + 63°, 245° + 72°, 333° + 28°.

Mr. W. E. Besley, at Clapham Common, London, registered the paths of 110 meteors between July 14 and 24, and the great majority of these were seen on the 23rd (30 meteors) and 24th (51 meteors). His results are important, for on the former date he found the radiant point of the Perseids at 23° + 51°, and on the latter date at 25° + 52½°, from 5 and 7 meteors respectively.

Prof. A. S. Herschel, at Slough, during a series of short watches between July 17 and August 1, recorded 53 meteors, including some very interesting early Perseids and several Aquarids. The position of the latter radiant was placed at 339° − 12°, from about 7 paths.

Some of the meteors seen by Prof. Herschel were also noted by the writer at Bristol. The earliest Perseid of which duple observations were secured appeared on July 19, at 11h. 49m., and it was a fine object, estimated to equal Jupiter by the Bristol observer. The radiant from the combined paths was at 17° + 50°, and the height of the meteor varied during its descent from 81 to 54 miles. Another Perseid was seen at Slough and Bristol on July 23, 12h. 12m., of 1st magnitude. Its radiant was at 24° + 52°, and height 84 to 55 miles. These radiants, together with those determined by Mr. Besley on July 23 and 24, and that by the writer at Bristol on July 30, agree very satisfactorily with the ephemeris place of the radiant given by the writer in *Ast. Nach.*, 3546, and *Memoirs* R.A.S., vol. liii. p. 210.

Fairly bright Aquarids were recorded at Slough and Bristol on July 28 and 30, with heights from 65 to 44 miles and 56 to 40 miles respectively. These meteors are usually lower in the atmosphere than the Perseids, and move much slower. If we take the radiant of the former shower in 1900 as 339° − 11°, we shall probably have a position which is certainly within 1° of probable error.

On July 15, at 10h. 13m., a Capricornid fireball was seen at Bristol and four other places. It was a splendid object, about three times brighter than Venus, in the northern part of England. It fell from heights of 51 to 21 miles, along a path of 78 miles; velocity, 16 miles per second.

On July 17, at 8h. 47m., a magnificent fireball appeared over the northern part of England and Scotland. Though the sun had not long set, the brilliancy of the meteor was described as very dazzling, and the nucleus left a streak which remained visible for three-quarters of an hour. The meteor was directed from a radiant at 249° − 20° in Scorpio, and fell from a height of 58 to 15 miles, along a path of about 175 miles.

On July 24 another fireball appeared, and was rated at about three times the brightness of Venus. It was seen at Bristol and at several stations in the eastern counties. It fell from 68 to 27 miles, along a path of 103 miles; velocity, 19 miles per second, and was directed from a well-known July radiant at 280° − 15°.

But the number of brilliant meteors which have recently appeared is so large that the objects cannot be alluded to in detail. Many ordinary shooting stars have also been doubly observed, and these will be tabulated and published at a later period. Among these there was an interesting θ Perseid on July 23, 11h. 13m., with heights of 83 to 59 miles, and a radiant at 30° + 47°, quite distinct from the true Perseids.

On about August 10–12 the radiant of the Perseids was found far east of its place in July. On August 12, Mr. King, at Leicester, determined the position as 48½° + 58° from 16 Perseids, and Mr. Besley derived it at 47° + 56½° on the same night from 4 meteors. On August 16 the writer at Bristol saw 5 Perseids from a radiant at 54° + 58°.

Though the shower was partially obliterated by moonlight just at the important time, it has this year furnished some interesting materials for discussion as regards its earlier and later stages. W. F. DENNING.

WHAT PRESSURE IS DANGEROUS ON ELECTRIC RAILWAYS WITH OVERHEAD TROLLEY WIRES.[1]

THE following investigations were set on foot on account of a dissension between the firm of Messrs. Brown, Boveri and Co., Switzerland (Baden), and the authorities regarding the proper pressure for two different electric railways to be worked by three-phase alternating current, namely, the lines Stansstad-Engelberg and Fermatt-Garnergratt, which lines it was proposed to work at a pressure of 750 volts. But this pressure being regarded as dangerous, the authorities refused to allow one exceeding 500 volts to be actually employed.

In these circumstances the firm communicated with Prof. H. F. Weber, of the Zürich Polytechnic, asking him to express his opinion on this matter. In view, however, of his own want of experience on this particular point, Prof. Weber commenced a long series of investigations of the physiological effects of the electric current on the human body, and he used himself as the measuring instrument, thus exposing himself to great danger.

The experiments were made with reference to the special circumstances of the above railways, where the current was supposed to be supplied through two overhead leads, the rails being used as the third conductor of the three-phase system.

Two series of experiments were made corresponding with the cases—

(*a*) A person seizes the two bare leads with both hands simultaneously, or both of the leads fall on a bare part of the human body.

(*b*) A bare part of a person standing on the railway or on a car comes into contact with one of the leads.

The apparatus used in the case of experiments (*a*) consisted of an iron ring wound with 630 turns of wire, through which was sent an alternating current, the frequency of which was 50 per second. The voltage between the first and the last turn was kept at 210 volts. To every thirtieth turn was soldered a copper wire of 10 cm. length, and 6 mm. diameter, and consequently the pressure between the first and the second wire was 10 volts, that between the first and third 20 volts, and so on, up to 210 volts.

Prof. Weber tried these pressures successively on himself, constantly holding with one hand the first wire and seizing with the other hand each of the other wires in succession. The experiments were made three times, his hands being each time wetted to begin with, and afterwards being used dry. The results of each of the three series so obtained were consistent with one another.

When experimenting with *wet hands* he obtained the following results:—

P.D.	Effect.
10 volts.	Very feeble trembling of the muscles of the fingers; the current from hand to hand was measured and found to be 0·001 ampere.
20 volts.	Very considerable trembling of the hands, wrists and forearms; the hands and the arms were able to be moved freely, and the wires could be

[1] By William Rung, C.E., of the firm of Brown, Boveri and Co., Switzerland. Translated from the Danish *Civilengeneer* by F. Lehmann, M. F. Danish C.E.