

trations of pictures taken by some of the more well-known photographers, and many other subjects too numerous to mention, but which are of practical use to the amateur. Great pains have apparently been taken to ensure the successful reproductions of the pictures included in the 370 pages which compose this volume, and a perusal of even these alone may give hints to many amateurs on the somewhat difficult tasks of lighting, pose, &c.

THE additions to the Zoological Society's Gardens during the past week include a Gazelle (*Gazella dorcas*, ♀) from Egypt, presented by Mr. J. S. N. Allison; a White-cheeked Hill Partridge (*Arboricola atrigularis*) from the Naga Hills, Assam, presented by Mr. K. S. Cassells; a Regent Bird (*Sericulus melinus*, ♂) from Australia, a Weka Rail (*Ocydromus australis*) from New Zealand, a Black-headed Lemur (*Lemur brunneus*), bred in the Gardens, deposited; two Glitons (*Gulo luscus*, ♂ ♀) from Northern Europe, a Common Otter (*Lutra vulgaris*), British; three Australian Rails (*Rallus pectoralis*), two White-cheeked Honey-eaters (*Meliphaga sericea*) from Australia, a Red Ground Dove (*Geotrygon montana*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

COMET CHASE.—This comet, which is now about as bright as it was at the time of its discovery last year, has the following ephemeris for the current week:—

		Berlin Midnight.		
1899.		R.A. (app.)	Dec. (app.)	
		h. m. s.		
Jan. 21	...	11 9 55	...	+ 32 27.7
23	...	9 55	...	32 50.7
25	...	9 48	...	33 13.4
27	...	9 35	...	33 35.9
29	...	11 9 16	...	+ 33 57.9

VELOCITY IN THE LINE OF SIGHT OF η PEGASI.—In a previous number of the *Astrophysical Journal* (vol. viii. No. 3), Prof. Campbell pointed out that his observations had indicated that the motion in the line of sight of the star η Pegasi (R.A. 22h. 38<sup>m</sup>. 2<sup>s</sup>. Dec. + 29° 41' 2", mag. 3.1) is variable. Writing in the *Astronomische Nachrichten* (No. 3536), Herr Belopolsky tells us that he is able to corroborate this statement from observations made by him at the Pulkova Observatory. The following are the results of his measures of this star, the number in the last two columns representing the velocities per second in geographical miles, in relation to the earth and sun respectively.

		Motion relative to			
		Earth	Sun.		
1897	Aug. 27	...	-1.70	...	-0.66
	Sept. 8	...	-1.03	...	-0.64
1898	Aug. 25	...	+1.27	...	+2.29
	Sept. 17	...	+3.05	...	+2.26

The mean of Belopolsky's values for the two years thus reduce to -4.8 and +16.9 kilometres per second, while those of Campbell for 1897 July-September and 1898 August-September, are given as -4.3 and +16.2 kilometres per second. These values it will be noticed agree well with one another, and indicate further the accuracy that can now be obtained in such measures.

THE LEONIDS IN 1898.—In the December number of the *Monthly Notices* there are several communications on the meteors seen in November last, to which we have not yet drawn our readers' attention. At the Cape Observatory, Dr. Gill had made special provision for obtaining both eye observations and photographs on the nights of the 13th and 14th.

For the latter work, five cameras were arranged to cover the region round the radiant point, while a Cooke doublet was directed towards the radiant. All the cameras were fixed to equatorials, and the plates changed every hour. No photographic results were obtained, and, indeed, the eye observations indicated that the shower was nothing out of the ordinary. No more fortunate was Dr. Copeland, who, with some assistants,

watched on the nights of the 13th to 15th. At Cambridge, Mr. Hinks, who with several other observers kept their vigil during the same three evenings until dawn, and were perhaps a little more fortunate on the 14th, when from 11h. to 18h. thirty-two Leonids were seen.

The shower seems, however, to have been better seen in America, as will be gathered from the following extracts of a letter from Prof. Barnard to Dr. Johnstone Stoney. Prof. Barnard watched on the nights of the 11th-16th, between the hours 5 p.m.-6 a.m.

He writes:—"The sky cleared shortly after midnight on the 14th. I soon saw there were a few meteors, but not noticeable, which could be traced back to the radiant, though they were mostly low in the north-west, near α Cygni. They became more frequent, and some large ones were seen. From this till daylight several hundreds were seen—many of the first magnitude, and a few brighter. Very few were seen near the radiant, and none at it." As regards the time of greatest frequency of the meteors, Prof. Barnard says:—"It seemed to me the maximum was reached between 3 and 4 a.m., perhaps nearer 4. It was the finest display of meteors I have yet seen."

On the 16th and 17th, not a single Leonid was observed by Prof. Barnard. Five cameras were employed to record the trails, but the development of the least promising of them has given no trails.

NEW INSTRUMENT FOR MEASURING ASTROGRAPHIC PLATES.—Now that photography is so largely used for obtaining charts of the stars, several styles of measuring instruments have been devised to obtain directly the coordinates of the star discs from the negatives. The great difficulty in designing such instruments is that simplicity of construction, accuracy of measurement, and rapidity of working must be well combined. The most recent form is that which we owe to Dr. Gill, and which will be found fully described and illustrated in the *Monthly Notices of the R.A.S.* (vol. lix. No. 2). While taking advantage of the rapidity of Prof. Turner's method, Dr. Gill has retained the accuracy which is attainable with the filar micrometer. The result, as Dr. Gill states, has fully realised his expectations, "thanks to the artistic skill and care of Messrs. Repsold, to whom I entrusted the carrying out of my plans." The whole process of measurement is "so simple that an observer without any previous knowledge or experience in practical work of the kind can, after very short training, easily measure the two coordinates of eighty stars per hour (including diameters); and were it not that the observers are instructed to work very carefully, a larger number could be measured in the same time."

THE SPECTRUM OF THE CORONA.<sup>1</sup>

THE announcement by Prof. Nasini of the possible presence of the characteristic green line of the corona in the spectrum of the gases collected at the Solfatara of Pozzuoli (*NATURE*, vol. lviii. p. 269, July 21, 1898) renders it desirable that I should at once publish some of the results of an investigation relating to the spectrum of the corona with which I have lately been occupied.

In the course of my early observations of the spectrum of the chromosphere, I discovered on June 6, 1869, a bright line at 1474 on Kirchhoff's scale, which I stated to be coincident with a line of iron (*Roy. Soc. Proc.*, vol. 18, p. 76).

During the total eclipse of the sun on August 7, 1869, a green line was recognised by Prof. Young as belonging to the spectrum of the corona, and the position of this line was also stated to be 1474K.

Although other determinations of the position of the green line of the corona during eclipses have not all agreed absolutely with Young's observations, the differences have been attributed to errors of observation, so that Young's statement of the coincidence of the coronal and chromospheric lines, and their correspondence with the solar dark line at 1474K has been generally accepted. No special attention appears to have been directed of late years to the measurement of the corona line itself.

This and other coronal radiations were photographed as rings by the use of prismatic cameras in 1893, 1896, and 1898, but a full list of them has only so far been published for the photo-

<sup>1</sup> Paper read before the Royal Society on November 24, by Sir Norman Lockyer, K.C.B., F.R.S.

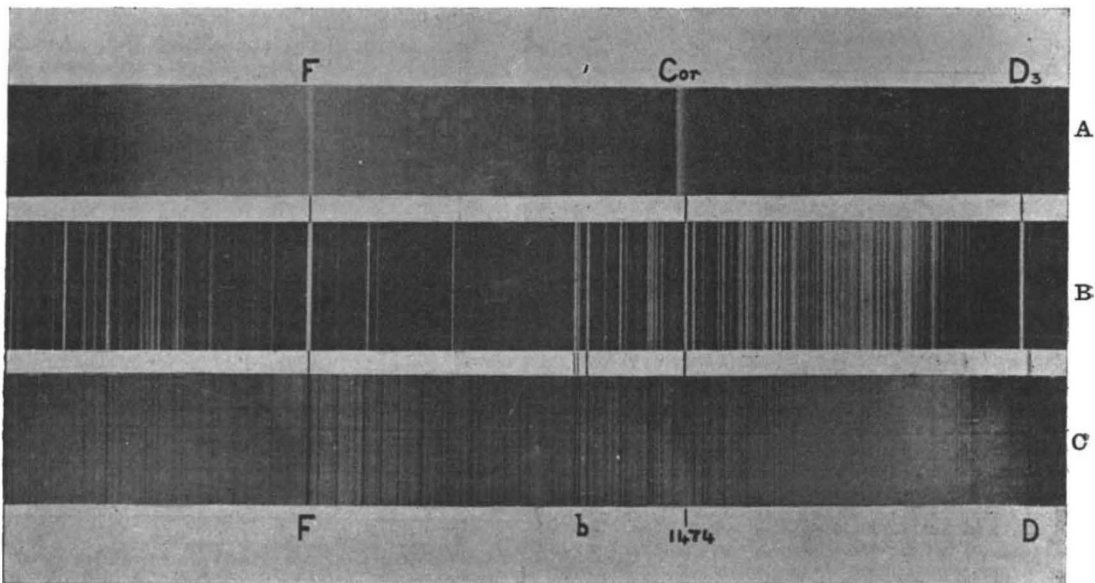
graphs taken by Mr. Fowler during the eclipse of 1893 (*Phil. Trans.*, A, vol. 187, p. 593). Among the brightest of these rings, which is common to all three sets of photographs, is one about wave-length 4231, which probably is identical with the corona line photographed by Schuster in 1886, and stated to have a wave-length of 4232·8 on Angström's scale (4233·4 Rowland). Schuster stated that this line was "probably the same line as 4233·0 often observed by Young in the chromosphere" (*Phil. Trans.*, A, vol. 180, p. 341). The chromospheric line at this wave-length has since been identified as an enhanced line of iron, of which the precise wave-length is 4233·3. Captain Hills photographed this corona line with a slit spectroscope in the last eclipse, and he gives its wave-length as 4233·5 (*Roy. Soc. Proc.*, vol. 64, p. 54), which within the limits of error might be considered coincident with the enhanced line of iron.

The later researches on the spectrum of iron have shown that the iron line which I observed in 1869 to be coincident with the bright chromospheric line at 1474K (5316·79 Rowland) is also an enhanced line, agreeing absolutely with Young's latest determination of the wave-length of the 1474 chromospheric line (Scheiner's "Astronomical Spectroscopy,"

With regard to the ring in the green, the lack of sufficient photographs on isochromatic plates in 1893 does not permit of a final determination of wave-length. Important data, however, were obtained, both in 1896 and 1898. A measurement of the position of the chief ring in the green, as shown in these photographs, comparing the ring with the spectrum of the chromosphere and a solar and iron spectrum taken by the same prisms, shows beyond all question that the wave-length is very different from that generally accepted. The mean result of measurements of different parts of the ring made by Messrs. Fowler and Shackleton and Dr. Lockyer is 5303·7, or about 13 tenth-metres more refrangible than 1474K (5316·79).

Although the new wave-length is not to be regarded as final, for the reason that the conditions under which the photographs were taken necessitate certain small corrections which have not yet been fully worked out, it is not likely that it can be in error by so much as 1 tenth-metre.

The examination of the photographs, which has been undertaken in the first instance by Mr. Fowler, indicates that other important conclusions are to be drawn from the admirable series obtained by him, among them the possible existence of one or more new gases, some of the lines of which, as gathered from the



Comparison of the position of the chief line in the spectrum of the corona (A) with the enhanced line of iron at 1474K, seen in the spectrum of the chromosphere (B) and in the ordinary solar spectrum C.

Frost's translation, p. 425), with which, according to his eclipse observations, the green line of the corona is coincident.

According to these results then, two of the chief lines in the spectrum of the corona would be coincident with enhanced lines of iron. The remaining corona lines which have so far been measured, are not, however, coincident with enhanced lines. It did not seem possible, therefore, that two of the enhanced lines of iron should be present without the others, even if it be admitted that the corona may have a temperature high enough to produce any enhanced lines.

It appeared then, either that the coincidences of the chromospheric and coronal lines about 423 and 531 were accidental, or that they were not real coincidences at all. A careful examination of the eclipse photographs of 1896, taken by Mr. Shackleton, and those of 1898, taken by Mr. Fowler, has therefore been undertaken, with special reference to this point.

The wave-length of the coronal ring at 4231, already published in case of the 1893 photographs, has been confirmed.

The 1896 and 1898 photographs further indicate that the corona line near 4231 is not coincident with the chromospheric line to which reference has been made, and show that while the chromospheric line is coincident with the enhanced line of iron at 4233·3, the corona line has a wave-length of 4231·3.

dispersions as yet available, appearing also in the spectra of some stars and planetary nebulae.

The photograph which accompanies this paper has been prepared by Mr. Fowler.

#### HIGH VACUA PRODUCED BY LIQUID HYDROGEN.<sup>1</sup>

AS an illustration of the extraordinary power of the new cooling agent—liquid hydrogen, the extreme rapidity with which high vacuo can be produced by its use is, perhaps, one of the most striking. The absolute boiling points of hydrogen, oxygen, and chlorine are respectively 35°, 90° and 240°, in other words oxygen boils at a temperature two and a half times higher than liquid hydrogen, and liquid chlorine similarly at two and a half times that of liquid oxygen. From this we infer that liquid hydrogen as a cooling agent ought to be relative to liquid air as effective as the latter is compared to that of liquid chlorine. Now chlorine at the temperature of boiling oxygen is a hard solid, some 80° below its melting point, and in this condition has an excessively feeble vapour pressure.

<sup>1</sup> "Application of Liquid Hydrogen to the Production of High Vacua, together with their Spectroscopic Examination." Paper read at the Royal Society on December 15, 1898, by James Dewar, F.R.S.