

perature curve." As I have previously pointed out, the "feebly developed" stars of the group are probably either early or late species, as the bands would be weak in either case. If it be an early star, the bands in the blue will be most strongly developed; while, if it be a late star of the group, the bands in the red will be strongest. In the latter case, lines would probably also be seen.

(3) Konkoly classes this with stars of the solar type. As in former stars of this class which have appeared in these columns, observations are required to decide whether the star belongs to Group III. or to Group V. (For criteria, see p. 20.)

(4) This is a star of Group IV., of which observations of the relative intensities of the hydrogen and metallic lines are required, so that the star may be arranged in a line of temperature with others.

(5) This is a star of Group VI., which Dunér describes as having a spectrum consisting of three zones, band 2 being probably also present. Particular attention should be given to the intensity of the band 6 as compared with the others. Other subsidiary bands should also be looked for, as they are seen in several stars of lower magnitude, and it is important that we should know whether their presence is dependent solely upon the brightness of the star, or really indicates a difference in the condition of the star itself. (For notation of bands, see p. 112.)

(6) The maximum of this variable will occur on December 27. The period is 315 days, and the magnitude varies from < 13.5 at minimum to 8.6 at maximum. The spectrum has not yet been recorded.

*Note.*—Some of the comets of which ephemerides have recently appeared in NATURE may possibly be bright enough for spectroscopic examination. It is not likely that, at their present perihelion distances, their temperatures will be very high, so suggestions for comparison spectra may be confined to those suitable for low-temperature comets. The probable sequence of spectra as a comet leaves aphelion is as follows:—(1) The spectrum of a planetary nebula, as in the comets of 1866-67, observed by Dr. Huggins. This consists of a single line in the position of the chief nebula line near  $\lambda$  500. (2) The low-temperature spectrum of carbon, consisting chiefly of three flutings near  $\lambda$  483, 519, and 561. (3) The high-temperature spectrum of carbon, consisting mainly of flutings near  $\lambda$  564, 517, and a group of five flutings extending from 468 to 474. The most convenient comparison to begin with will be the flame of a spirit-lamp, which will give the hot carbon spectrum. If this does not show coincidences with the cometary bands, a comparison with the bright fluting in the spectrum of burning magnesium should be made. This will determine the presence or absence of the chief nebula line. If neither shows coincidences, the positions of the bands relatively to the hot carbon flutings may roughly indicate the presence or absence of cool carbon. As the two less refrangible flutings of cool carbon fall very near to two of hot carbon, the best criterion for cool carbon is the fluting at  $\lambda$  483, which is about one-third of the distance from the fluting commencing at 474 towards that commencing near 517. Any variation of the form of the least refrangible cometary band from the corresponding carbon fluting should be noted, as this varies with the temperature (see Roy. Soc. Proc., vol. xlv. p. 168). A. FOWLER.

PHOTOMETRIC INTENSITY OF CORONAL LIGHT.—The observations made by Prof. Thorpe during the solar eclipse of 1886 (Phil. Trans., vol. clxxx., p. 363, 1889) show that the diminution in intensity of coronal light at different distances from the sun's limb does not vary according to the law of inverse squares. The following measurements make this apparent:—

Distance in Solar Semi-diameters.	Photometric Intensity.	
	Observed.	Law of Inverse Squares.
1.6	0.066	0.066
2.0	0.053	0.042
2.4	0.043	0.029
2.8	0.034	0.022
3.2	0.026	0.016
3.6	0.021	0.013

The brightness of the brightest measured part of the corona (1.55 solar semi-diameters) was 200 times less bright than that of the surface of the moon, or about 0.06 candle, whilst the furthest spot at 3.66 solar semi-diameters was only 1/800 of the brightness, or 0.015 candle. The results obtained will be useful in comparing the brightness of the corona on this occasion with that of other eclipses, and determining what connection the sun-spot periods have with the coronal phenomena.

CORONA OF JANUARY 1, 1889.—Prof. Tacchini, in the *Atti della R. Accademia dei Lincei* (p. 472), gives a note on the corona as shown in a positive copy, on glass, of one of Mr. Barnard's negatives taken during this eclipse. The corona extends, according to Prof. Tacchini, from +64° to -68° on the west limb of the sun, and from +53° to -68° on the east limb, these being about the limits of the zone of the maximum frequency of protuberances derived from his own observations. Two of the protuberances on the photograph were observed at Rome and at Palermo.

MINOR PLANET (12), VICTORIA.—Dr. Gill has issued the ephemeris of this planet for the opposition of 1889, computed from elements which have been corrected from the observations of 1888.

Observatories co-operating in the meridian observations of Victoria should compare their results with this ephemeris, employing 8".80 for the solar parallax.

Dr. Auwers has undertaken the discussion of the meridian observations, so the detailed results should be forwarded to him as soon as possible.

COMET SWIFT (*f* 1889, NOVEMBER 17).—The following ephemeris is given by Dr. R. Schorr (*Astr. Nachr.*, No. 2937):—

1889.	R.A.	Decl.	1889.	R.A.	Decl.
	h. m. s.	°		h. m. s.	°
Dec. 12...	23 47 28	+19 6.7	Dec. 22...	0 19 7	+21 49.4
13...	50 31	19 23.6	23...	22 24	22 4.8
14...	53 36	19 40.4	24...	25 43	22 20.1
15...	56 42	19 57.1	25...	29 2	22 35.2
16...	59 50	20 13.6	26...	32 23	22 50.1
17...	0 2 59	20 29.9	27...	35 44	23 4.8
18...	6 10	20 46.1	28...	39 6	23 19.3
19...	9 22	21 2.2	29...	42 30	23 33.6
20...	12 35	21 18.1	30...	45 54	23 47.7
21...	15 50	21 33.8	31...	49 18	24 1.5

The brightness of the comet = 0.81 (December 12) and 0.57 (December 31), that at discovery being taken as unity.

*Comptes rendus*, No. 23 (December 2, 1889), contains observations of this comet extending from November 20 to November 27. It is noted that the comet is very feeble and diffuse.

PERIODIC COMETS.—Several short-period comets return to the sun in 1890, and their ephemerides will be furnished as soon as issued. The perihelion passage of Brorsen's comet will occur about February 25, Denning's comet may be expected to return to perihelion in May, and D'Arrest's comet about the third week in September. The orbit of Barnard's comet has not yet been sufficiently defined to enable the date of perihelion passage to be stated.

THE ECLIPSE PARTIES.—The following telegram relating to the eclipse parties has been received:—"Loanda, December 7.—The United States corvette *Pensacola*, Captain Arthur R. Yates, with the Solar Eclipse Expedition on board, arrived at St. Paul de Loanda to-day. The voyage down was very smooth, with delightful sailing. The astronomers were at work on the instruments all the way, and are all ready for the eclipse. The time is now so short that it is inadvisable to attempt to take the party and all their instruments inland, so the Expedition will locate at Cape Ledo immediately, and send one or two branch parties inland, with such instruments as are not bulky or heavy, and can quickly be set up and adjusted. The European eclipse observers are beginning to arrive here. Mr. Taylor, of the Royal Astronomical Society, London, has already arrived with a small outfit of apparatus. None of the French or German astronomers are yet here. Cape Ledo turns out to be in every way the most favourable point for locating the American Expedition. Not only are the meteorological conditions likely to be better, but the party can live for the most part on the *Pensacola*, as she will lie at a safe anchorage near the shore. The health of the members of the party is thus insured. The eclipse is several seconds longer there than at Muxima, and chances for clear afternoon skies appear to be rather better. If nothing is heard from the Expedition for the next few days, it may either be taken that the Eclipse Station is finally located at Cape Ledo, or that the semi-cannibal Quissamas have cleared out the whole Expedition."

RECENT INDIAN SURVEYS.

THE "Statement exhibiting the Moral and Material Progress and Condition of India," recently issued, devotes, as usual, a section to the survey work of the past year, of

which the following is a summary. The work of the Survey of India is divided under five heads, namely:—(1) Trigonometrical Survey, (2) Topographical Survey, (3) Cadastral Survey, (4) Special Surveys and Explorations, (5) Map Production.

*Trigonometrical.*—Out of twenty-six survey parties employed during the year, only one was engaged on trigonometrical work. It carried secondary triangulation for 370 miles along the Coromandel coast as far as the Tanjore District; the work is intended as a basis for marine survey operations. Some triangulation in extension of the great Indian triangles had to be undertaken in Baluchistan as a basis for topographical maps there.

*Topographical.*—The number of parties engaged in this work was reduced from eight to six, and 15,673 square miles of topographical survey were accomplished, which included 934 square miles of survey in the Southern Mahratta country, the same party doing a quantity of detached forest survey in the valuable teak forests of Kanara; 1085 square miles of topographical work in Guzerat, besides 285 square miles of detailed forest survey in the jungles of Thana and Nasik. Parties 15 and 16 continued the Baluchistan survey, accomplishing in all 11,977 square miles. The cold and snow in winter, as well as the difficulty in getting supplies, were extremely trying to the parties. 977 square miles were surveyed in the Himalayan districts of Kangra, Simla, and the native States pertaining to those districts; 4535 square miles of triangulation and 1284 square miles of topographical survey in the Madura district and the States of Travancore and Cochin of South India. The cost of the Himalayan work and of the Baluchistan surveys was considerably cheaper per square mile than in the previous year.

*Forest Surveys.*—Two half-parties of the Topographical Survey did fresh work, as above stated, in Bombay. Ground was broken in the forests near Hoskungebad of the Central Provinces; but in the first year, on account of climatic difficulties and the ruggedness of the country, the out-turn of work was small. 343 square miles of forest survey were effected in the forests of the Prome and Thayetmyo districts of Lower Burmah. In Gorakpur of the North-West Provinces, and in Orissa, surveys of certain forest reserves were made by cadastral parties working in the neighbourhood. The whole area of forest surveys accomplished by all these parties during the year was 893 square miles.

*Geodetic.*—Telegraphic longitude operations were resumed, and seven arcs of longitude were measured between trigonometrical stations in Southern India. The season's observations tend strongly to confirm previous evidence that on the coast of India there is a perceptible deviation of the plum-line towards the ocean.

*Tidal and Levelling Operations.*—The recording of tidal curves by self-registering tide-gauges, their reduction, and the publication of tide-tables, were continued at eighteen stations, of which seven are permanent, and eleven are temporary for five years. The registrations of tides were satisfactory, and there were few failures. So far as predictions of high water were concerned, 98 per cent. of the entries in the tables were correct within 8 inches of actual heights at open coast stations, and 69 per cent. at riverain stations, while as to time of high water, 56 and 71 per cent. respectively of the entries were correct within fifteen minutes. Levelling operations were prosecuted from Madras to Vizagapatam, at False Point, to connect the Marine Survey beach marks with the main line of level, and from Chinsurah to Nuddea, along the right bank of the Hooghly. There were 597 miles of double levelling accomplished. In Upper Burmah, survey parties or surveyors accompanied the columns which marched through the northern Shan States, the southern Shan States, and the columns that operated in the Yaw country, the Chindwan Valley, and the Mogoung district. Triangulation was carried over 23,274 square miles, and 20,780 square miles of hitherto unknown country were mapped on a scale of four miles to the inch, of which 7605 belonged to the Shan States. North-east from Mandalay, the survey was carried as far as the Kanlow ferry, on the Salween River, a place on the old caravan road between Burmah and China. A large scale map was made of the Ruby Mines tract, showing the sites of all ruby workings. Surveyors accompanied an exploring expedition from the Assam Valley, across the Patkoi ranges, into the Hukong Valley of Upper Burmah, and surveyed two practical passes through the Patkoi hills. A good map of the Black Mountain country was prepared on observations and surveys taken by officers deputed with the Hazara field force. The hill country of Western Nepal has been observed and

mapped, and a compilation of recent observations by explorers in Tibet and Bhutan will shortly be published.

*Marine Survey.*—The survey-vessel *Investigator* and two boat parties were employed on marine surveys throughout the open season, the staff being employed in the chart office during the monsoon months. The *Investigator* accomplished 4630 miles, and the boat parties 1542 miles of soundings. Among the results of the year's work were soundings round the approaches to Madras, whereby it was shown that there were 1700 fathoms of water on a spot hitherto marked on the charts as "5 fathoms doubtful." Surveys were made round the Laccadive and the Andaman Islands, at the Palk Straits, the Western Coral Banks, on the Malabar coast near Cannanore and Tellicherry, and off Parbandar. Interesting marine organisms, some of them quite new, were brought up by the trawler, especially from a depth of 250 fathoms off the Andamans. The observations for temperature have enabled the survey to construct a temperature curve which is fairly constant for all parts of those seas.

*Geological Survey.*—Among the investigations by the Geological Survey during the year 1888 may be mentioned the examination of the auriferous rocks known as the Dharwar rocks, bands of which occur in the gneiss mountains, from the edge of the Deccan trap in the meridian of Kaladgi, across the upper basins of the Kistna, Tangabhadra, Pennar, and Cauvery Rivers. At many places in the bands of Dharwar rock, the geological officers discovered traces of extensive gold workings, the existence of which was hardly known to the present inhabitants. The investigators consider that in many places, especially in the Kolar and Maski bands, gold will be found in quantities that will repay working. The workers of past centuries used to crush the ore in saucer-like hollows in the solid, tough, trappoid rocks, with rounded granite crushers, weighing about a ton each. The supposed diamond sources in the Anantapur district of Madras were examined, but with only negative results. The coal-field of Singareni, in the Nizam's dominions, was examined; it was estimated that 17,000,000 tons of coal were available in the field. The geologists reported that the cost of raising coal into waggons at the pit's mouth ought not eventually to exceed 2 rupees a ton. Further examinations were made of the coal-bearing rocks of Western Chota Nagpore and of Rajmehal; the latter coal source cannot be thoroughly tested until bore holes are put down. The seams of coal at Kohst, in Baluchistan, were found to contain 1½ to 2 feet of good coal at times; coal from surface workings is now chiefly used in locomotives; but the best plan for permanent workings has not yet been settled. The petroleum sources at Khatun, in Baluchistan, and in the Rawal Pindi district of the Punjab, were visited by officers of the Survey; the Khatun oil is too thick to flow down a pipe for forty miles to the railway, where it has made excellent fuel. The Cashmere coal-field, in the upper valley of the Chenab, was also examined.

The report of the Cadastral Surveys and Settlements is devoid of scientific interest.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—In the course of the term which has just come to an end, Mr. J. B. Farmer, B.A., has been elected to a Fellowship at Magdalen, after an examination in botany—a subject to which no Fellowship has been allotted for many years; and the Burdett-Coutts Scholarship in Geology has been awarded to Mr. F. Pullinger, Corpus.

Mr. Hatchett Jackson will continue to act as Deputy Professor of Comparative Anatomy for the next two terms at least.

The recently founded Readership in Geography seems to have proved a success this term, as Mr. Mackinder had a class of fifty in regular attendance.

#### SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 21.—“On the Tubercles on the Roots of Leguminous Plants, with special reference to the Pea and the Bean.” By H. Marshall Ward, M.A., F.R.S., F.L.S., late Fellow of Christ's College, Cambridge, Professor of Botany