

tion with the clamp of the instrument both west and east. It is better in his opinion to determine for each instrument the necessary corrections to be applied by means of the methods and formulæ explained in this paper.

In discussing the flexure of vertical circles Prof. Harkness compares Repsold's method of eliminating the flexure, by interchanging the object and eye-end of the telescope, with Bessel's method of attaining the same result by observing a star both directly and by reflection with the clamp successively west and east, demonstrating the superiority of the latter method, which appears to be the most satisfactory procedure hitherto devised for freeing an observed declination from the effect of flexure.

Prof. Harkness shows that when there are terms in the flexure depending on multiples of the zenith distance, they cannot in general be completely eliminated, and therefore that star-places derived from observations made with a single instrument are likely to be affected by systematic errors, which will appear when the work of different instruments is compared together. The detection and elimination of such errors can probably, Prof. Harkness thinks, be greatly facilitated by the use of equal altitude instruments of the zenith telescope class, which are so remarkably free from systematic errors.

THE SPECTRUM OF FABRY'S COMET.—M. Trépid having frequently observed the spectrum of this comet since April 7, gives (*Comptes rendus*, vol. cii., No. 18) the following account of it. The three usual cometary bands were seen, and as the brightness of the spectrum allowed a fairly narrow slit, 0.2 mm., to be used, the coincidence of these bands with those of the hydrocarbon spectrum could be very satisfactorily verified. Besides these bands there was also a continuous spectrum, but the remarkable feature of the case was that although the nucleus, which was very distinct and of a truly stellar appearance, appeared very bright as compared with the neighbouring portions of the coma, the band spectrum given by these latter and by the tail was much more brilliant than the continuous spectrum of the nucleus. This circumstance, which was also observed by MM. Thollon and Perrotin at Nice, had been remarked by M. Trépid in Encke's comet last year. He is therefore led to conclude that there is a predominance of gaseous elements in both these comets, and that, further, the relative brilliance of the nucleus of a comet is not necessarily in accord with the degree of condensation of the cometary matter.

On April 14 the bright bands could be easily detected in the spectrum of the tail to a distance of 20' from the nucleus. The total length of the tail was then more than 3°.

TWO NEW COMETS.—Mr. W. H. Brooks, Red House Observatory, Phelps, New York, discovered two new comets in the last week of April, the first on April 27, the second on April 30. The former is described by M. Bigourdan as being on May 1 a round nebulous object, about 2' in diameter, brighter towards the centre, but without a nucleus. The existence of a very faint nucleus was, however, suspected on the following night. On May 6 Lieut.-Col. Tupman estimated the comet as being of the 8th magnitude. Dr. H. Kreutz has computed the following elements and ephemeris for it:—

$$T' = 1886 \text{ June } 6.9585 \text{ Berlin M. T.}$$

$$\left. \begin{aligned} \omega &= 202^{\circ} 55' 68'' \\ \Omega &= 191^{\circ} 48' 58'' \\ i &= 87^{\circ} 33' 03'' \end{aligned} \right\} \text{Mean Eq. } 1886^{\circ} 0$$

$$\log q = 9.40752$$

Ephemeris for Berlin Midnight

| 1886 | R.A. | Decl. | Log Δ | Brightness |
|--------|----------|------------|--------|------------|
| | h. m. s. | ° ' " | | |
| May 13 | 2 9 38 | 51 43.7 N. | 0.1062 | 2.2 |
| 17 | 2 30 25 | 47 52.2 | 0.996 | 2.9 |
| 21 | 2 49 32 | 43 25.9 | 0.931 | 4.1 |
| 25 | 3 7 48 | 38 17.2 | 0.865 | 6.2 |
| 29 | 3 26 26 | 32 15.3 N. | 0.0794 | 10.0 |

The brightness on April 29 is taken as unity.

The second comet is described (*Astr. Nach.* No. 2728) by the Baron von Engelhardt as being very bright on May 3, although the evening was misty. The comet was visible in a bright field, and showed a circular nucleus, from whence proceeded a brighter offshoot, 2' in length, in the direction of the axis of the tail. The tail was 8' in length and very bright, narrow at first, but broadening by degrees, and curved with the convex side towards the north. A secondary tail, 6' in length, faint, and bending

towards the south, forked off from the principal tail about 6' from the nucleus. The following elements and ephemeris are by Dr. E. Lamp:—

$$T = 1886 \text{ May } 4.13040 \text{ Berlin M. T.}$$

$$\left. \begin{aligned} \omega &= 37^{\circ} 50' 15'' \\ \Omega &= 287^{\circ} 22' 88'' \\ i &= 99^{\circ} 47' 53'' \end{aligned} \right\} \text{Mean Eq. } 1886^{\circ} 0$$

$$\log q = 9.92518$$

Error of middle place (O - C).

$$d\lambda = + 0'.19 \quad d\beta = - 0'.02$$

Ephemeris for Berlin Midnight

| 1886 | R.A. | Decl. | Log r | Log Δ | Brightness |
|--------|----------|------------|--------|--------|------------|
| | h. m. s. | ° ' " | | | |
| May 12 | 23 52 46 | 47 23.0 N. | 9.9326 | 9.9924 | 1.0 |
| 14 | 0 5 38 | 51 23.8 | 9.9364 | 9.9980 | 0.9 |
| 16 | 0 20 38 | 55 10.5 | 9.9410 | 0.0056 | 0.9 |
| 18 | 0 38 9 | 58 39.8 | 9.9462 | 0.0149 | 0.8 |
| 20 | 0 58 38 | 61 49.5 | 9.9520 | 0.0255 | 0.8 |
| 22 | 1 22 15 | 64 35.6 | 9.9583 | 0.0373 | 0.7 |
| 24 | 1 49 21 | 66 55.8 | 9.9652 | 0.0501 | 0.6 |
| 26 | 2 19 47 | 68 48.4 | 9.9725 | 0.0636 | 0.5 |
| 28 | 2 52 55 | 70 11.7 | 9.9802 | 0.0775 | 0.5 |
| 30 | 3 27 37 | 71 5.8 N. | 9.9881 | 0.0918 | 0.4 |

The brightness on April 30 is taken as unity.

NEW MINOR PLANET.—A new minor planet, No. 258, was discovered on May 4 by Dr. Luther at Dusseldorf, R.A. 15h. 20m., Decl. 9° 31' S.; daily motion, R.A. - 48s., Decl. + 7'; mag. 11.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 MAY 16-22

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on May 16

Sun rises, 4h. 8m.; souths, 11h. 56m. 9.3s.; sets, 19h. 44m.; decl. on meridian, 19° 9' N.; Sidereal Time at Sunset, 11h. 22m.

Moon (Full on May 18) rises, 17h. 51m.; souths, 23h. 5m.; sets, 4h. 10m.*; decl. on meridian, 11° 22' S.

| Planet | Rises | | Souths | | Sets | | Decl. on meridian |
|---------|-------|----|--------|----|-------|-----|-------------------|
| | h. m. | s. | h. m. | s. | h. m. | s. | |
| Mercury | 3 | 34 | 10 | 24 | 17 | 14 | 9° 7' N. |
| Venus | 2 | 48 | 9 | 4 | 15 | 20 | 2° 29' N. |
| Mars | 12 | 23 | 19 | 13 | 2 | 3* | 8° 57' N. |
| Jupiter | 13 | 52 | 20 | 10 | 2 | 28* | 2° 53' N. |
| Saturn | 6 | 37 | 14 | 49 | 23 | 1 | 22° 49' N. |

* Indicates that the setting is that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

| May | Star | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image |
|-----|--------------|------|--------|---------------|--|
| | | | h. m. | h. m. | ° ' " |
| 17 | η Libræ | 6 | 22 16 | 23 32 | 64 240 |
| 19 | 24 Scorpii | 5 | 0 37 | near approach | 167 — |
| 21 | δ Sagittarii | 5 | 22 1 | 22 57 | 19 266 |
| 22 | B.A.C. 6658 | 6 | 5 2 | near approach | 206 — |

Variable Stars

| Star | R.A. | Decl. | h. m. |
|--------------|---------|----------|----------------|
| | h. m. | ° ' " | |
| ζ Geminorum | 6 57.4 | 20 44 N. | May 20, 2 20 m |
| V Virginis | 13 21.9 | 2 35 S. | 17, 20 m |
| δ Libræ | 14 54.9 | 8 4 S. | 16, 2 8 m |
| U Ophiuchi | 17 10.8 | 1 20 N. | 16, 0 44 m |
| | | | 21, 1 30 m |
| X Sagittarii | 17 40.4 | 27 47 S. | 19, 2 25 m |
| | | | 22, 0 0 m |
| W Sagittarii | 17 57.8 | 29 35 S. | 21, 21 40 m |
| β Lyræ | 18 45.9 | 33 14 N. | 16, 0 0 m |
| S Vulpeculæ | 19 43.7 | 27 0 N. | 17, m |
| η Aquilæ | 19 46.7 | 0 7 N. | 19, 0 0 m |
| δ Cephei | 22 24.9 | 57 50 N. | 20, 21 35 m |

M signifies maximum; m minimum.

Positions of the Comet Barnard (for Berlin Midnight)

| May | R.A. | | | Decl. | Log. Δ | Brightness |
|-----|------|----|----|-----------|---------------|------------|
| | h. | m. | s. | | | |
| 16 | 2 | 20 | 49 | 28° 0' N. | 9.682 | 284 |
| 18 | 2 | 35 | 41 | 23 17 | 9.637 | 318 |
| 20 | 2 | 53 | 8 | 17 23 | 9.596 | 349 |

GEOGRAPHICAL NOTES

AMONGST the members of the mission proceeding from India to Tibet, under the charge of Mr. Colman Macaulay, are Col. Tanner, surveyor, Dr. Oldham, geologist, and Dr. Cunningham, naturalist. The expedition will leave Darjeeling about the end of the present month, and, marching through independent Sikkim, will cross the Jalepla Pass into Tibet. Its destination is Lhasa, the capital. Once only has this city been visited by an Englishman, Thomas Manning, and practically the whole route lies through a *terra incognita*. As Mr. Macaulay bears letters from the Chinese authorities, for which he made a special journey to Peking last year, it is not anticipated that he will meet with any obstacles on his way to, or during his stay on, "the roof of the world." The three scientific members of his mission will find abundance of work to do, and the news of the progress of the expedition may be looked for with interest.

THE new number of the *Journal* of the Royal Asiatic Society (vol. xviii., part 2) contains an interesting article by Mr. Morison, of Tiflis, on the geographical distribution of Turki languages. The following is a summary. Dividing Turki into five sub-branches—Turki proper, Nogai, Uigur, Kirghiz, and Yakut—he states that the various subdivisions of, first, Turki proper, are spoken by the ruling class of the Ottoman Empire and the inhabitants of Asia Minor, in the Governments of Nijni Novgorod, Kasan, Simbirsk, Viatka, and Orenburg, in Transcaucasia, and North-Western Persia; the Nogai in Bessarabia, the Crimea, Cis-Caucasia, the Volga Delta, North-Eastern Daghestan, Terek Valley, the north-western shore of the Caspian, the Governments of Kasan and Simbirsk, Astrakan, Orenburg, and Ufa; the Uigur in Yarkhand and Chinese Tartary, the country of the Tekke, Zarafshan Valley, and generally in Central Turkestan, in the Khanate and Desert of Khiva and south of the Aral Sea, and in Kuldja; the Kirghiz from the Volga to the confines of Manchuria, but most compact in South-Western Siberia; and the Yakut in North-Eastern Siberia and on the northern slopes of Mount Sayan. Broadly speaking, says Mr. Morison, the Ugro-Altaic languages, of which Turki is one, are spoken over a region extending through more than 100° of longitude, from the shores of the Adriatic to the Great Wall of China and the plateau of Tibet, and through 35° of latitude, from the frozen steppes of Samoyede and Yakut to the plains of Northern Persia and the head-waters of the Indus. The Turki alone, according to the figures given, is spoken, in one or other of its various forms, by more than 20,000,000 of people.

THE *Proceedings* of the Royal Geographical Society for May contains a paper by Mr. Carles on his recent journeys in Corea, accompanied by a very useful map of the peninsula. Some account of these journeys has already appeared in Parliamentary Blue-Books, but much is added in the present paper. The writer refers to the many different types found amongst the Coreans of the present day; the facial characteristics of the people greatly resemble those of the Manchus, but Jews, Japanese, and Caucasians appear to be universally represented. There is also a curious reference to evidence of some forms of religion other than those imported from China in the *miriok*, or half-length human figures carved in stone. Mr. Needham also contributes an account of an excursion to the Abor Hills from Sadiya in Upper Assam.

BARON MIKLUHO-MACLAY has just returned to Odessa from his journey to New Guinea, which has lasted two years. He has brought a large collection of rare fishes, lizards, snakes, insects, and so on, packed in twenty-two boxes.

ANOTHER Russian traveller, M. Goudatti, the Secretary of the Moscow Society of Friends of Natural Science, who has also just returned from his journey to the north of Siberia, gives a curious account of his failure to accomplish his purpose. The Ostiaks and Samoyedes took him for a Government official on a recruiting mission, especially when he attempted to measure

their heads, and took notes in his note-book. Finally the book was stolen, and all the results of his efforts lost.

HERR RADDE, who had started in January last with a scientific expedition from Tiflis to the Transcaspien region, writes from Askabad lately that this spring was very unfavourable for his researches, being three to four months later than usual. Therefore up to the middle of April he had not succeeded in collecting more than 35 species of plants and about 150 birds. Amongst these latter there is an interesting novelty, the *P. cus sindiacus*, a pretty bird living in the high shrubs of *Tamarix*. The explorer intends to proceed during the present month to the mountain region between the Murghab and Tejen, and to return to Askabad through Sarakhs.

THE May number of the *Scottish Geographical Magazine* has an interesting article by Mr. Tripp on the physical configuration and rainfall of South Africa, with notes on its geology, diamond and coal-fields, and forests. The paper is accompanied by two maps showing contours and mean annual rainfall. A note by M. Dingelstedt on geographical education in the schools of the Caucasus shows that in Russia primary instruction in geography is as defective as in England. It is not made attractive, the writer complains; it only taxes the memory; the text-books are written to match, and few teachers are equal to the task of interesting their pupils in the subject. There are some interesting notes on the place-names of Kinross-shire by Mr. Liddall, and on the seaboard of Aberdeenshire, by Mr. Ferguson. The geographical notes are particularly copious and comprehensive.

THE current number (Bd. xiii. No. 4) of the *Verhandlungen* of the Berlin Geographical Society contains only one paper—a lecture by Dr. Naumann on the Japanese Islands and their inhabitants. The *Zeitschrift* of the same Society (Bd. xxi. Heft 2) is mainly occupied by a paper of Dr. Schweinfurth's on a journey which he made in the "region of depression" around Fayoum at the commencement of the present year. It is accompanied by a map, and fills 53 of the 66 pages forming the number. There is a short paper of great interest on the Maori population of New Zealand, based on the last census of that colony. The writer (who does not give his name) discusses the causes of the dying out of the race, and also the attitude of the Colonial Government towards the Maories. There is a note from Prof. Kunze on the climatology of South America, and, lastly, a long list of barometrical observations by Lieut. Francois in the Kassai region.

THE SUN AND STARS¹

VI.

Summary of Results

IN what has gone before we have found that the prominences, and the spots, have special spectra unlike the ordinary spectrum of the sun, and unlike the spectra of the chemical elements.

Further, we know that when we proceed outwards to the spectra of the inner and outer corona we find ourselves very little better off, for, with the exception of hydrogen, there is no substance which is perfectly familiar to us; and finally, when we come to study the association of phenomena on the sun, we find that, exactly while the spots and prominences give us the greatest divergences from terrestrial conditions, solar facts indicate that these phenomena are allied in the most close and obviously important manner. We must henceforth consider that the spots and the metallic prominences and the faculæ represent different indications of the same solar action.

Now, to continue this part of the inquiry is fundamental for us. It is almost impossible to see a large spot at the edge of the sun, which is the place for observing it best, without finding this downrush towards the photosphere answered, so to speak, by an uprush from below the photosphere—without finding this downrush of cool, absorbing, dark-and-widened-line-producing material, re-echoed by an uprush of bright-lined substance.

There is one word which expresses, as well as anything I can think of, the impression which is made on one by the phenomena. There is a *splash*. Imagine an enormous cauldron of liquid iron, as hot as you like. Play some water into it from a hose; there will be a splash. The water, of course,

¹ A Course of Lectures to Working Men delivered by J. Norman Lockyer, F.R.S., at the Museum of Practical Geology. Revised from shorthand notes. Continued from vol. xxxiii. p. 543.