ing a spot maximum the sun's atmosphere is becoming more and more disturbed. At the time of greatest obscuration the blood-red tinge, caused by the absorption of our atmosphere, became very apparent, but this gradually wore off as the brighter part of the moon made its appearance.

From a series of photographs of the eclipsed moon taken at intervals of about a quarter of an hour, the penumbra in some of them was very distinct, especially in those taken near the time of greatest obscuration, the exposures then being comparatively long. At mid eclipse an attempt was made to obtain a photograph of the whole disk of the moon, as it appeared so distinct and clear on the ground glass, but even an exposure of 12s., using extra rapid dry plates and a 30-inch reflector, was not sufficient to bring it out, although the extent of the bright crescent and penumbra was very much increased.

DECLINATIONS OF STARS FOR REDUCTION OF VARIATIONS IN LATITUDE.—No. 263 of the *Astronomical Journal* contains the declinations of thirty-six stars, which have been obtained with the prime-vertical transit of the United States Naval Observatory. The observations were made for the determination of the constant of aberration, and consequently at the periods of maxima aberration effects, but their present publication, as Prof. S. J. Brown states, is owing to the "many requests for the observed declinations of these stars for use in discussing probable secular and periodical changes in latitude." The stars in this list are comprised in the zone 36° 37′—38° 40′. The communication contains a brief account of the methods of reduction employed, together with a reference to the instrumental adjustments.

The same number of the *Journal* contains also some results of the observations of α Lyræ, made during the years 1862–67 with the same instrument as mentioned above. The discussion of these observations was first made when Euler's value of 306 days for the periodical variation of the latitude was in vogue, but Prof. S. Newcomb, in the present case, has taken Mr. Chandler's new value, and gives, briefly, the following results:—

Mean declination of α Lyræ for 1865·0, assuming the latitude of the centre of the Observatory to be 38° 53′ 39″·25	38° 39′ 35″·56
Correction to Struve's constant of aberration...	+ 0″·006
Hence, constant of aberration	20″·451
Parallax of α Lyræ	+ 0″·24
Coefficient of sun's azimuth in declination ...	+ 0″·507
Coefficient of sin N	s = + 0″·086
Coefficient of cosine N	c = − 0″·087

the value of N being assumed zero at 1864·50, increasing 308° annually.

The expression which he gives for the variation of the latitude of Washington is

$$\delta\phi = 0''\cdot122 \cos 308^\circ (t - 1864\cdot94),$$

the distance between the poles, or the semi-amplitude of the variation of the latitude, being 0″·122.

COMET 1892 DENNING (MARCH 18).—The following elements and ephemeris are given for this comet in the *Astronomische Nachrichten*, No. 3089, computed from three observations made at the Hamburg Observatory:—

T = 1892 May 11·22042 Berlin M.T.

$$\left.\begin{aligned}\omega &= 129^\circ\ 18'\ 34''\cdot4\\ \Omega &= 253\ 25\ 41\cdot6\\ i &= 89\ 42\ 4\cdot3\end{aligned}\right\}\text{ M. Equator 1892·0.}$$

$\log q = 0\cdot294619.$

Ephemeris for 12h. Berlin M.T.

1892.	α App. h. m. s.	δ App. ° ′	log r.	log. Δ.	Br.
May 19	3 49 27	+52 13·5			
20	52 26	51 57·7			
21	55 22	51 41·8	0·2947	0·4423	0·80
22	58 15	51 25·9			
23	4 1 5	51 10·0			
24	3 52	50 54·1			
25	6 37	50 38·2	0·2948	0·4466	0·79
26	9 19	50 22·3			

The brightness at the time of discovery is taken as unity.

COMET 1892 SWIFT (MARCH 6).—The elements and ephemeris of this comet are given in the *Edinburgh Circular* (No. 26), from which we make the following extract:—

1892.	R.A. h. m. s.	Decl. ° ′	log Δ.	log r.	Br.
May 19	23 23 44	+31 52·2			
20	26 16	32 22·2			
21	28 47	32 51·6	0·1522	0·1035	0·53
22	31 16	33 20·4			
23	33 44	33 48·7			
24	36 10	34 16·5			
25	38 34	34 43·7	0·1628	0·1166	0·47
26	40 56	35 10·4			

The brightness at the time of discovery is taken as unity.

The comet is situated in the constellation of Pegasus, and on the 22nd will form very nearly an isosceles triangle with β Pegasi and α Andromedæ, the comet then lying nearly midway between η Pegasi and σ Andromedæ.

GEOGRAPHICAL NOTES.

M. LOUIS LÓCZY, in his annual address to the Hungarian Geographical Society at the commencement of the current session, expressed surprise that scientific geography was so little appreciated in England. "It is sad to see," he said, "that, despite the efforts of the oldest of Geographical Societies, the great Universities of Oxford and Cambridge have not yet established chairs of geography, and that lectureships even have only been established with difficulty."

IN the Report of the Mississippi River Commission, the extent of the levees confining the river below Cape Girardeau (Missouri) is given as 1300 miles. During the high water of 1891, the levees gave way in five places, and the total length of the breaches made in the embankment was about one mile. By far the most serious gap was that at Ames Plantation, opposite New Orleans, which attained a width of 1665 feet, and a maximum discharge of about 91,000 cubic feet per second. It overflowed 2000 square miles, one-tenth being cultivated land. The cause of this crevasse was a badly constructed rice-flume, and as the great Nita crevasse of 1890 had a similar origin, the Commission has resolved to discountenance the use of such flood-gates in future. All of the crevasses of 1891 put together discharged less water than the Nita crevasse alone in the previous year, and it was only one out of about fifty breaks which occurred during the great floods.

A NEW map of Dahomey, on the scale of 1 : 500,000, has been prepared by M. A. L. d'Albeca, and published as a supplement to the new journal, *La Politique Coloniale*. All available data have been employed in its preparation, much being of course derived from itineraries unchecked by observation.

CAPTAIN GALLWEY, Vice-Consul for the Oil Rivers Protectorate, has succeeded in tracing a channel navigable for canoes through the deltaic swamps between Benin and Lagos, a distance of 160 miles.

THE *Proceedings* of the Royal Geographical Society for May contains a letter from Mr. Gilbert T. Carter, Governor of Lagos, describing a recent journey into the interior. From the summit of a hill near Ode Ondo he obtained a magnificent view to the south-east over a foreground of rocky forest-clad hills, backed by a fine range of mountains about twenty miles away, which have not previously been reported. The height of the most conspicuous summits is estimated to be from 5000 to 8000 feet above sea-level.

THE VARIATION OF TERRESTRIAL LATITUDES.

IN a letter addressed to M. R. Radau by M. Antoine d'Abbadie, which appears in the March number of the *Bulletin Astronomique*, the writer gives an interesting historical account of the work that has been done with regard to this question. As it contains also some suggestions for future work, the following *résumé* may be of service.

The author states that M. Fergola, the astronomer at Naples, may be looked upon as the one who first drew attention to this question. Of the earlier astronomers, Sir George Airy was led to the conclusion that the latitude was subject to a slight variation, and he published in 1854 and 1875 the greatest and least values for the co-latitude 38° 31′ 22″·16, and 38° 31′ 21″·35 respectively, obtained from observations of the pole. Many other results were obtained by him, which caused him to assign reasons for the fluctuations, but he deemed it wiser to publish the results at a time when the measurement by graduated circles was considered more concise.

One of the first causes to which these variations were attributed was refraction, and it was with the intention of settling this point that Airy undertook with his zenith telescope the measurements of the zenith distance of γ Draconis, as this star culminated near the zenith at Greenwich. M. Faye, towards the year 1846, found out the advantages of such an instrument as that used by Airy, and his installation was composed of three instruments, a zenith telescope, a mercury trough, and a nadir telescope, the last two of which provided a means of obtaining the true nadir point.

Porro, an Italian officer, adopted several of these improvements in his instrument: he added to his telescope a trough with a glass bottom, the plane surface of which was placed in a horizontal position, and reflected feebly the image of the central thread of the zenith telescope. By filling the trough with water, another image of the same wire was obtained, which remained visible during the transit of the star, and it was possible to take several measures of the distance between the star and image.

The next observer we find occupied in this research was Respighi, who, in the year 1872, published the nadir distances of several stars measured at Rome. The stars he observed were those which culminated so near the zenith that they could be seen in the telescope after reflection from mercury. From a series of seventy-seven observations, taken during five months of the year 1869, he observed the transits of two stars reflected at his nadir. During this interval he found a difference of 2″·07 between the greatest and least of his results.

In the method of Horrebow, the divided arc on his instrument gave a rough reading of the inclination of his telescope, while for greater precision he used the readings taken from a level fitted to the telescope.

M. d'Abbadie here condemns the use of levels altogether for really accurate work, and backs his opinion with facts which he has obtained from personal experience. He mentions that, as far back as 1837, he made a study of their accuracy, but the levels he used were not good ones. Later, after having purchased some from the best-known makers in Paris, Munich, London, and Hamburg, he repeated his experiments in a cellar in an old *château*, and he found that the results given were of a most unsatisfactory kind.

Admitting, then, that there was a variation in the latitude, it was not long before periods were established. Peters, in the year 1845, from observations at Pulkova, derived one of 303·9 days with a maximum on November 16, 1842. Mr. Nyrèn extended this to 305·6 days, with a maximum on December 13, 1867, while Mr. Downing, from ten years of observations made at Greenwich, deduced a period of 306·0 days, with a maximum on October 12, 1872. Leverrier, and Hough at Albany, also found variations that were confirmed at Abbadia.

M. d'Abbadie then refers to the variation of the true azimuth, which, as he says, did not escape the notice of Airy. In the year 1848 he estimated it as 4″ or 5″, while fifteen years later he extended it to 6″ or 7″. Of course, if the pole suffers any displacement, such as an increase in elevation, at its two elongations it will be displaced by the same amount, and the azimuths in these cases would be increased. The greatest displacement we have mentioned is 2″·07, but M. d'Abbadie says "that if, by hypothesis, the north pole of the earth be elevated by 7″ by approaching the actual zenith, the true azimuth will be diminished by those 7″ in a place situated at 6h. 0m. of west longitude, and increased by the same quantity at 6h. 0m. of east longitude." He then states how, if the pole was considered movable for places situated at opposite ends of a diameter of the earth, the values for the variation should be the same, but of opposite signs. To establish coincidences of this kind, it is suggested that observers in Asia and America should take their nadir readings at the same time as they are taken at Abbadia—that is, in the morning and evening at 6h. Paris mean time. The results Chandler obtained from his latitude observations indicated a minimum on September 1, 1884, and a maximum on May 1, 1885, with a difference of about 0″·7. By taking the 6 o'clock p.m. P.M.T. observations made at Abbadia, it was found that a maximum value was obtained on September 1, 1884, and a minimum on May 1, 1885, with a difference of 0″·74. Contemporary observations made at Berlin and Honolulu tended also to the same conclusion; but in spite of them M. d'Abbadie does not think it prudent to suppose a fluctuation of the earth's axis.

After referring to some sudden changes that this variation has undergone, he goes on to mention Darwin's, Wolf's, and Paschwitz's instruments that were constructed for the measurement of very small displacements. The last-named modified to a large extent Zöllner's horizontal balance, and added to it a mirror, obtaining in this way, by the employment of photography, a continuous series of curves.

Mr. Nobile, in his memoir of 1883, related that, in 1820, Brioschi believed in the small changes in the terrestrial latitudes, and admitted two possible variations, one secular and another periodic. He states, also, that Fergola, in 1871, supported this idea of Brioschi; and Peters, as well as Nyrèn and Gylden, confirmed this opinion. Euler and Legendre are also said to have concluded from theory such a variation, giving it a period of ten months.

Another memoir by M. Nobile, contains a discussion on the observations that were made with the object of determining the latitude of the Observatory at Capo di Monte, near Naples, and from these, together with some others, he deduced a tendency in the latitude to increase in the summer and decrease in the winter months.

It will be seen from the preceding summary that very little is definitely known as to the causes of this variation. From the observations just referred to, it seems that refraction would be the cause of such a variation, but as this is not borne out in other observations, new theories must be advanced. M. d'Abbadie, knowing the importance that is attached to the inquiries into the causes of these variations, before concluding his letter adds a few suggestions relative to a means of settling some of these points, and the following is the plan which he proposes should be adopted.

Three observers, A, B, and C, should be provided each with a good zenith telescope; and the same two stars, which it is proposed to use, should be observed by them. B and C should be as near as possible on the same parallel of latitude, so as to have identical refractions when measuring the declination on the meridian of the chosen stars. To insure greater accuracy in these declinations, he suggests that these stars should be observed at their elongations with a geodetical circle, the refraction in azimuth being zero, save in a few rare cases of lateral refraction. The three observers should "notify at once, in a continuous way, if possible, the varying movements of the nadir, and, in every case, these variations at the precise moment where A would observe on the meridian."

To further complete this plan, two other observers, at D and and E, might be added, the former situated at 6h. east, and the latter at 6h. west longitude, in the same relative positions as Paris is to Calcutta and Chicago. The position of E or D could be chosen in the austral hemisphere, in order to determine whether the variation of the nadir agrees with that which should be observed simultaneously in the opposite hemisphere. Still greater advantage would be gained if two other observers, situated at opposite points of the earth, were chosen to observe these phenomena at the same instant. By adopting this plan, a definite control would be had over the hypothesis that the fluctuation was due to the movement of the terrestrial axis, and if only this point could be settled, we should have advanced a considerable step in its solution.

We may mention here that quite recently Chandler has made the remarkable discovery that the earth's axis of rotation revolves round that of her maximum moment of inertia in a period of 427 days. This, as Prof. Newcomb says, seems at first to be quite contrary to the principles of dynamics, but, after having investigated the theory, he finds that it is in perfect harmony with the amount that the latitude varies, taking into account the elasticity of the earth itself and the mobility of the ocean. Radau's investigations were based on a 306-day period, but he showed that the observed discordances would have to be multiplied three times before they agreed with those obtained by theory.

W. J. L.