routine work in connection with the maintenance of the system of colonial time signals; a number of observations of the zenith distances of northern stars and circumpolars both above and below the Pole, for the comparison of declinations as observed at Observatories on either side of the equator; and some progress as having been made in the observation of pairs of equi-zenith distance stars for the determination of the latitude of the Observatory. The various computations undertaken at the Observatory have been pushed forward much more zealously. These embrace the comparison of the Greenwich lunar observations for the decade 1878-87 with Hansen's lunar tables; the reduction of Mr. Campbell's observations of the lunar crater Murchison A, made at the Arkley Observatory in the years 1882-84; and the reduction of the third year's tidal observations at Durban.

THE SPECTRUM OF R ANDROMEDÆ.—Mr. Espin, who has recently discovered bright lines in the spectra of several long-period variables of Secchi's third type, has added another to the list; R Andromedæ, at the maximum just passed, showing a number of bright lines, F being very bright, so bright as to appear to project beyond the spectrum. The spectrum of the star had manifestly undergone a great change from the time when Dunér made the very thorough study of it which he has recorded in his work on "Les Étoiles à Spectres de la Troisième Classe." Five of the seven variables included in Mr. Lockyer's Species 10 of this type have now shown bright lines at maximum, whilst Gore's Nova Orionis, which should certainly be included in the same species, would make a sixth. The two stars in which bright lines have not yet been observed are R Leonis Minoris and α Herculis.

COMET 1889 *d* (BROOKS, JULY 6).—The following ephemeris is in continuation of that given in NATURE for October 3 (p. 550):—

Ephemeris for Berlin Midnight.

1889.	R.A. h. m. s.	Decl. ° ′	Log r.	Log Δ.	Brightness.
Nov. 1	23 41 40	2 32·2 S.	0·2977	0·0625	1·8
5	23 42 56	2 3·6	0·2988	0·0754	1·7
9	53 44 39	1 33·1	0·3001	0·0888	1·6
13	23 46 49	1 0·8	0·3015	0·1025	1·5
17	23 49 25	0 27·0 S.	0·3030	0·1163	1·4
21	23 52 25	0 8·4 N.	0·3046	0·1303	1·3
25	23 55 49	0 45·2	0·3063	0·1445	1·2
29	23 59 34	1 23·3 N.	0·3082	0·1587	1 1

The brightness at discovery is taken as unity.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1889 *NOVEMBER* 3-9.

(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 November 3

Sun rises, 7h. 0m.; souths, 11h. 43m. 40·4s.; daily increase of southing, 0·5s.; sets, 16h. 28m.: right asc. on meridian, 14h. 35·4m.; decl. 15° 13′ S. Sidereal Time at Sunset, 19h. 21m.

Moon (Full on November 7, 16h.) rises, 15h. 30m.; souths, 21h. 1m.; sets, 2h. 45m.*: right asc. on meridian, 23h. 54·5m.; decl. 6° 7′ S.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m.	° ′
Mercury..	5 8	10 37	16 6	13 28·3	6 53 S.
Venus ...	4 29	10 9	15 49	13 0·0	4 37 S.
Mars ...	2 35	8 54	15 13	11 45·3	3 5 N.
Jupiter ...	11 38	15 31	19 24	18 23·6	23 27 S.
Saturn ...	0 22	7 28	14 34	10 19·5	11 53 N.
Uranus ...	5 16	10 36	15 56	13 28·0	8 37 S.
Neptune..	17 30*	1 18	9 6	4 8·4	19 15 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Saturn, November 3.—Outer major axis of outer ring = 39″·3; outer minor axis of outer ring = 5″·8: southern surface visible.

Meteor-Showers.

	R.A. °	Decl. °	
Near γ Camelopardalis...	55	71 N.	Swift.
,, the *Pleiades*	60	20 N.	The *Taurids.*
,, θ Ursæ Majoris ...	143	50 N.	Very swift.
From Lacerta...	346	52 N.	Rather slow.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.
U Cephei	0 52·5	81 17 N.	Nov. 4,	1 23 *m*
			,, 9,	1 3 *m*
R Canis Majoris ...	7 14·5	16 11 N.	,, 6,	17 5 *m*
			,, 7,	20 20 *m*
S Cancri	8 37·6	19 26 N.	,, 3,	21 22 *m*
U Ophiuchi... ...	17 10·9	1 20 N.	,, 5,	18 29 *m*
R Scuti	18 41·6	5 50 S.	,, 8,	*m*
U Aquilæ	19 23·4	7 16 S.	,, 9,	21 0 *M*
χ Cygni	19 46·3	32 38 N.	,, 6,	*m*
T Vulpeculæ ...	20 46·8	27 50 N.	,, 9,	21 0 *m*
Y Cygni	20 47·6	34 14 N.	,, 4,	15 40 *m*
			,, 7,	15 35 *m*
δ Cephei	22 25·0	57 51 N.	,, 8,	23 0 *M*

M signifies maximum; *m* minimum.

SEISMOLOGICAL WORK IN JAPAN.[1]

THE seismological work which has been accomplished in Japan is to a great extent described in fourteen small volumes published by a Society which was organized in 1880 to study phenomena connected with earthquakes and volcanoes. This Society is called the Seismological Society of Japan. An epitome of a portion of this work is to be found in nine Reports on the volcanic phenomena of Japan issued by this Association. A glance at the first few volumes published by the Seismological Society shows that the attention of its members was directed towards seismometry. For several years attempts were made to record earthquakes by using the old types of earthquake instruments, such as columns balanced on end, bowls or tubes filled with liquid, pendulums with pencils or pointers writing on paper or smoked glass. The records obtained from instruments of this order were, however, gradually recognized as being too indefinite; the instruments indicated that shakings had taken place, but they failed to measure them. All investigators recognized that to measure the movement of the earth it was necessary, while the movement was going on, to obtain a steady point or platform relatively to which the motion might be measured. By the patient labours of investigators in Japan, which have extended over many years, this has been accomplished, and we now have pendulums and other forms of instruments which for small displacements are in neutral equilibrium, so that when the frames carrying these instruments are shaken back and forth or up and down there are certain portions of them which remain at rest. From these steady points pointers project which write the movements or magnified representations of these movements upon suitably prepared surfaces.

From the simple pendulum and style, tracing its movements in sand, and costing but a few pence, elaborate instruments, embracing many new mechanical contrivances, and writing their movements with delicate siphons on continuously running bands of paper, have gradually been evolved. With the assistance of these instruments many thousands of diagrams, each of which represents in absolute measures the back and forth motions of the ground during an earthquake, have been obtained, and we now know the true nature of earthquake movement. We have learnt that, in many earthquakes which are quite perceptible and sometimes even alarming, the amplitude of motion may not exceed a millimetre, while if it reached 25 millimetres, or an inch, we might expect cities to be ruined.

The results which have flowed from a study of these diagrams are numerous and interesting. We now know that the direction of movement in any given earthquake is continually varying. At one moment a point on the surface of the earth may be moving north and south, and the next moment it may be moving east and west, while at other times it may be following a path too intricate to be easily described.

More interesting observations relate to the period and amplitude of the earth's motion, from which may be calculated the destructive power, which depends partly on the maximum velocity and partly on the suddenness of movement. Some earthquakes commence with preliminary tremors, which have been recorded with a frequency of eight or ten waves per second.

The back and forth movements of considerable amplitude which constitute the shock or shocks in an earthquake usually have a period of one or two seconds, while the ordinary back

[1] A Paper, by Prof. John Milne, of the Imperial University of Japan, Tokio, read at the British Association.

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