ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 NOVEMBER 28—DECEMBER 4

(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 28

Sun rises, 7h. 42m.; souths, 11h. 48m. 10·4s.; sets, 15h. 55m.; decl. on meridian, 21° 21′ S.: Sidereal Time at Sunset, 20h. 25m.

Moon (three days after New) rises, 9h. 52m.; souths, 14h. 15m.; sets, 18h. 39m.; decl. on meridian, 19° 7′ S.

Planet	Rises	Souths	Sets	Decl. on meridian
	h. m.	h. m.	h. m.	° ′
Mercury ...	8 40	12 35	16 30	23 11 S.
Venus ...	7 33	11 43	15 53	20 51 S.
Mars ...	10 27	14 14	18 1	24 15 S.
Jupiter...	3 55	9 12	14 29	9 14 S.
Saturn...	*19 5**	*3 7*	*11 9*	*21 25 N.*

* Indicates that the rising is that of the preceding evening.

Occultation of Star by the Moon (visible at Greenwich)

Dec.	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
3	h^1 Aquarii	$5\frac{1}{2}$	17 8	18 30	116 286

Dec.	h.	
3	5	Venus in superior conjunction with the Sun.
3	12	Mercury in inferior conjunction with the Sun.
4	4	Mercury at least distance from the Sun.

Variable Stars

Star	R.A.	Decl.		h. m.	
	h. m.	° ′			
U Cephei ...	0 52·2	81 16 N.	Nov. 28,	2 27	*m*
			Dec. 3,	2 6	*m*
Algol ...	3 0·8	40 31 N.	,, 1,	5 38	*m*
			,, 4,	2 27	*m*
ζ Geminorum ...	6 57·4	20 44 N.	Nov. 29,	0 0	*m*
			Dec. 4,	0 0	*M*
U Monocerotis ...	7 25·4	9 32 S.	Nov. 28,		*m*
S Cancri ...	8 37·4	19 27 N.	,, 28,	3 9	*m*
T Ursæ Majoris ...	12 31·2	60 7 N.	,, 29,		*M*
S Virginis ...	13 27·1	6 37 S.	,, 30,		*M*
β Lyræ ...	18 45·9	33 14 N.	,, 28,	21 30	*m*
			Dec. 2,	5 0	*m*
R Lyræ ...	18 51·9	43 48 N.	Nov. 28,		*M*
η Aquilæ ...	19 46·7	0 43 N.	Dec. 1,	2 30	*M*
δ Cephei ...	22 24·9	57 50 N.	Nov. 30,	2 0	*m*

M signifies maximum; *m* minimum.

Meteor Showers

The chief shower of the week is that of the *Taurids*; R.A. 60°, Decl. 49° N. Other radiants active at this time are as follows:—Near η Persei, R.A. 44°, Decl. 56° N., slow, faint meteors; near α Canum Venaticorum, R.A. 194°, Decl. 43° N., very swift, streak-leaving meteors; from Leo Minor, R.A. 155°, Decl. 36° N.; from near η Ursæ Majoris, R.A. 208°, Decl. 43° N. Fireball dates, November 29 and December 2.

TEN YEARS' PROGRESS IN ASTRONOMY[1]

II.

The Solar Spectrum.—In 1877 Dr. Henry Draper, of New York, by a series of most laborious, time-consuming, and expensive researches, discovered the presence of oxygen in the sun, evidenced in his photographs, not by fine dark lines, as in the case of elements previously recognised, but by bright, hazy bands. It is difficult to assign any reason why this gas should behave so peculiarly and so differently from others, and for this reason many high authorities are indisposed to accept the discovery. But the evidence of the photographs seems fairly to outweigh any such purely negative theoretical objections.

Other advances have been made in the study of the spectrum, due mainly to the great improvements in spectroscopic apparatus. Until recently it has not been easy to decide with certainty as to some lines in the spectrum whether they were of solar or telluric origin; the great bands known as A and B, for instance. It was only in 1883 that the Russian, Egoroff, succeeded in proving that these are produced by the oxygen in the earth's atmosphere. In his experiments, on a scale previously unknown, the light was transmitted through tubes more than 60 feet in length, closed at the end with transparent plates, and filled with condensed gas.

It was quite early pointed out that the sun's rotation ought to produce a shift in the position of lines in the spectrum according as the light is derived from the advancing or receding edge of the solar disk, and Zollner thought he could perceive it. The earliest *measures*, however, were, I believe, those obtained independently by Vogel and the writer in 1876. In the great bisulphide of carbon spectroscope of Thollon the displacement becomes easy of observation; and very recently Cornu, by taking advantage of it, and by an extremely ingenious arrangement for making a small image of the sun to oscillate across the spectroscope slit two or three times a second, has been able to discriminate at a glance between the telluric and solar lines; the former stand firm and fast, while the latter seem to wave back and forth.

In this connection also should be mentioned the great map of the solar spectrum, for which Thollon received the Lalande Prize of the French Academy of Sciences last January, and the still more accurate and important map photographed by Prof. Rowland, by means of his wonderful diffraction-gratings, and now in course of publication. Nor would it be just either to omit the earlier and less accurate maps of Fievez and Vogel, which, when published, were as far in advance of anything before them as they are behind the new ones; nor the maps just made by Prof. Smyth, of Edinburgh.

It was in connection with the construction of such a map by Mr. Lockyer, that he was led to his theory of the compound nature of the so-called chemical elements, partly as a result of his comparisons of the spectra of different substances with the solar spectrum, and partly in consequence of considerations drawn from certain phenomena observed in the solar and stellar spectra themselves. His first paper on the subject was read late in 1878. This "working hypothesis," as its author calls it, has met with much discussion, favourable and unfavourable. It unquestionably removes many difficulties and explains many puzzling phenomena; at the same time there are very serious objections to it, and some of the arguments upon which Mr. Lockyer originally laid much stress have turned out unsound. For instance, he made a great point of the fact that, after all precautions are taken to remove impurities, several elementary substances show in their spectra common lines—"basic lines" he called them—indicating, as he thought, a common component. He found in the solar spectrum about seventy of these "basic lines." Now, under the high dispersion of our newer spectroscopes, these lines, which were single to his instruments, almost without exception dissolve into pairs and triplets, and withdraw their support from his theory.

I suppose that at present the weight of scientific opinion is against him; but, for one, I do not believe his battle is lost. In view of the law of Dulong and Petit, which establishes a relation between the atomic weight and specific heat of bodies, it seems to be pretty certain that *hydrogen* cannot be the elementary "*urstoff*" out of which all other elements are made by building up, as he at first seemed disposed to maintain; this element stands apparently on no different footing from the rest. But I see no reason why the elements, as we know them, may not constitute one *class* of bodies by themselves, all built up out of some as yet more elemental substance or substances. The "periodic law" of Mendelejeff suggests such a relation. And our received theories so stumble, hesitate, and falter in their account of many of the simplest phenomena of the solar and stellar atmospheres, that a strong presumption still remains in favour of the new hypothesis. I am not prepared to accept it yet; but certainly not to reject it.

The Chromosphere.—The study of the chromosphere and prominences has been kept up, very systematically and statistically, by Tacchini in Italy, and with less continuity, but still assiduously, by several other observers. I do not know, however, that any new results of much importance have been arrived at. The list of bright lines visible in their spectra has been a good deal enlarged; and Trouvelot thinks he has observed *dark* prominences—objective forms that show, black but active, upon the background of bright scarlet hydrogen in the surrounding chromospheric clouds. It may be that he is right; but, so far

[1] "Ten Years' Progress in Astronomy, 1876-86," by Prof. C. A. Young. Read May 17, 1886, before the New York Academy of Sciences. Continued from p. 69.