



Day of Month.	Day of Week.	THE SUN.						THE MOON.						PHENOMENA, &c.		TABLE OF LIGHT.													
		Latitude of Boston.		Latitude of New York.		Latitude of Wash'ton.		East of Rocky Mts.		Bos-ton.		New York.		Wash-ington.		San Fran.		This table embraces the period between 6 o'clock P. M. and 6 o'clock A. M., the gradations of light being thus indicated:—											
		Rises.	Sets.	Rises.	Sets.	Rises.	Sets.	Souths.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Sunlight. Moonlight. Twilight. Daylight. Moonlight. Twilight. Daylight.												
1	Wd.	7 10	4 28	7 5	4 33	7 0	4 39	10 14	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	G 7 8 9 10 11 Mid. 1 2 3 4 5												
2	Th.	11	28	6	33	1	38	11 10	5 54	5 51	5 47	5 52	5 52	5 52	5 52	5 52	Mars sets, 6: 8 P. M.												
3	Fri.	12	28	7	33	2	38	P. M. 7	7 6	7 2	6 58	7 2	6 58	7 2	6 58	7 2	Venus sets, 7: 57 P. M.												
4	Sat.	13	28	8	32	3	38	1 5	sets.	sets.	sets.	sets.	sets.	sets.	sets.	sets.	☾ eve.												
5	S.	14	27	9	32	4	38	2 2	6 49	6 54	6 59	7 9	7 9	7 9	7 9	7 9	☾ eve.												
6	Mo.	15	27	10	32	5	38	2 57	7 49	7 54	7 58	8 8	8 8	8 8	8 8	8 8	2d Sunday in Advent.												
7	Tu.	16	27	11	32	6	38	3 49	8 50	8 54	8 58	9 7	9 7	9 7	9 7	9 7	Nicolas.												
8	Wd.	17	27	12	32	6	38	4 38	9 51	9 54	9 57	10 6	10 6	10 6	10 6	10 6	☾ eve.												
9	Th.	18	27	13	32	7	38	5 24	10 52	10 54	10 57	11 5	11 5	11 5	11 5	11 5	Conception of B. V. M.												
10	Fri.	19	27	14	32	8	38	6 7	11 51	11 52	11 54	mor.	mor.	mor.	mor.	mor.	Jupiter sets, 4: 16 A. M.												
11	Sat.	20	27	15	32	9	38	6 49	mor.	mor.	mor.	0 2	0 2	0 2	0 2	0 2	3d Sunday in Advent.												
12	S.	21	27	15	32	10	38	7 30	0 49	0 50	0 50	0 57	0 57	0 57	0 57	0 57	Lucy.												
13	Mo.	21	27	16	33	10	38	8 12	1 47	1 47	1 46	1 53	1 53	1 53	1 53	1 53	Venus sets, 8: 13 P. M.												
14	Tu.	22	27	17	33	11	38	8 55	2 45	2 44	2 42	2 49	2 49	2 49	2 49	2 49	☾ eve.												
15	Wd.	23	28	18	33	12	39	9 39	3 45	3 43	3 40	3 46	3 46	3 46	3 46	3 46	O Sapiientia.												
16	Th.	24	28	18	33	13	39	10 26	4 46	4 43	4 40	4 45	4 45	4 45	4 45	4 45	Mars sets 6: 1 P. M.												
17	Fri.	24	28	19	34	13	39	11 16	5 48	5 42	5 40	5 45	5 45	5 45	5 45	5 45	4th Sunday in Advent.												
18	Sat.	25	29	20	34	14	40	A. M. 6	6 49	6 44	6 40	6 44	6 44	6 44	6 44	6 44	Jupiter sets, 3: 33 A. M.												
19	S.	26	29	20	34	14	40	0 9	rises.	rises.	rises.	rises.	rises.	rises.	rises.	rises.	St. Thomas.												
20	Mo.	26	29	21	35	15	40	1 4	6 21	6 26	6 31	6 41	6 41	6 41	6 41	6 41	21st Winter begins 1: 8 P. M.												
21	Tu.	27	30	21	35	15	41	2 0	7 26	7 30	7 35	7 44	7 44	7 44	7 44	7 44	Venus sets, 8: 27 P. M.												
22	Wd.	27	30	22	36	16	41	2 55	8 33	8 37	8 40	8 49	8 49	8 49	8 49	8 49	Christmas Day.												
23	Th.	28	31	22	36	16	42	3 49	9 42	9 48	9 47	9 56	9 56	9 56	9 56	9 56	1st Sunday after Christmas.												
24	Fri.	28	31	23	37	17	42	4 42	10 52	10 54	10 55	11 3	11 3	11 3	11 3	11 3	St. John. [St. Stephen.												
25	Sat.	28	32	23	37	17	43	5 33	mor.	mor.	mor.	mor.	mor.	mor.	mor.	mor.	Innocents' Day.												
26	S.	29	32	24	38	18	44	6 23	0 3	0 2	0 4	0 11	0 11	0 11	0 11	0 11	Jupiter sets, 2: 59 A. M.												
27	Mo.	29	33	24	39	18	44	7 14	1 14	1 16	1 12	1 19	1 19	1 19	1 19	1 19	Mars sets, 5: 59 P. M.												
28	Tu.	29	34	24	40	18	45	8 6	2 25	2 30	2 21	2 27	2 27	2 27	2 27	2 27	Sylvester. ☾ eve.												
29	Wd.	29	35	24	40	19	46	8 59	3 36	3 43	3 30	3 35	3 35	3 35	3 35	3 35													
30	Th.	30	35	25	41	19	46	9 54	4 47	4 56	4 39	4 44	4 44	4 44	4 44	4 44													
31	Fri.	7 30	4 36	7 25	4 42	7 19	4 47	10 50	5 55	6 6	5 46	5 50	5 50	5 50	5 50	5 50													

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CHRONOLOGY, ECLIPSES, AND TIDES.

CYCLES.

Dominical Letter C	Golden Number 8	Solar Cycle 2
Epact 17	Julian Period 6582	

EXPLANATION OF THE CALENDAR.

The times of sun's and moon's rising and setting, given in the calendar, apply to the upper limbs of those luminaries, and account is taken of refraction, of semidiameter, and (in the case of the moon) of parallax. The risings and settings for Boston and New York are calculated for the meridian of Washington. In the case of the sun, these times will answer for any other meridians; in the case of the moon, two minutes should be added for every 15° of longitude west from Washington. The times of rising and setting of the moon's upper limb cannot be accurately observed, owing to that being the dark side of the moon at night.

The column headed "Phenomena," etc., contains the moon's phases, the conjunctions of the four principal planets with the moon, the times of rising and setting of the same planets, and the Sundays and Saints' Days of the English Calendar, whether the latter are rubricated or not.

In the table of light there is a space between two horizontal lines for each day of the month, and a vertical line for every hour between 6 P. M. and 6 A. M. The different kinds of shading distinguish the different kinds of light. Thus, turn to the 4th of July. It is the sixth Sunday after Trinity. In the table of light there is no shading from the hour of 6 to a little more than half-way from 7 to 8. This shows that the sun remains above the horizon until about 7:35. Next, a shading indicating twilight reaches nearly to the ten-hour line; this shows that twilight ends about 9h. 40m. P. M. Next, there is a perfectly black space until somewhat more than half-way from the one-hour line to the two-hour line; this shows that there is starlight or darkness until about 1h. 35m. A. M. of Monday, the 5th. Next, there is a stippled space until about a third of the way from the two-hour line to the three-hour line; this shows that there is moonlight until about 2h. 20m. Then there is a light shading until a little more than half-way from the four-hour line to the five-hour line; this shows that there is moonlight with twilight, until about 4h. 35m., when the beginning of a white space shows that sunrise takes place. The table of light is constructed for New York; but it will serve for any part of the country, if we bear in mind that twilight lasts longer in more northerly latitudes, and not so long in more southerly ones.

ECLIPSES.

In the year 1869 two eclipses will be visible in the United States,—a partial eclipse of the moon and a total eclipse of the sun.

The eclipse of the moon takes place on January 27th. The magnitude is $\frac{4}{5}$ of the moon's diameter, the northern part of the moon being eclipsed. The eclipse begins at the northeastern part of the moon, and ends at the northwestern part. It is noticeable that, on the Sierra Nevada, it would (owing to refraction) be possible to see a portion of the moon in eclipse while a portion of the sun is above the horizon.

The following table exhibits the times of the different phases for several places.

Phase.	Boston.	New York.	Washington.	Chicago.	San Francisco.
Moon enters Penumbra	h. m. 6 33.5	h. m. 6 21.9	h. m. 6 8.8	h. m. 5 27.7	Before Moon-rise.
Moon enters Shadow	7 44.2	7 32.6	7 20.5	6 38.4	
Middle of Eclipse	8 53.9	8 42.3	8 30.2	7 43.1	5h. 23.3m.
Moon leaves Shadow	10 3.5	9 51.9	9 39.8	8 57.7	6 37.9
Moon leaves Penumbra	11 14.2	11 2.6	10 50.5	10 8.4	7 48.6

A total eclipse of the sun is not only one of the most imposing spectacles of nature, but also one of the most important of astronomical phenomena. Although such an eclipse occurs nearly every year somewhere on the earth, yet the area within which it can be observed is so small that it happens to few persons to witness one in the course of a lifetime. There have been only two that were visible in any large part of the United States since the beginning of the present century, namely, those of 1806 and of 1834. Hence, a total eclipse, whose path lies through a large and thickly settled portion of our country, is an event whose interest cannot be exaggerated. Such an eclipse will take place in the United States on the afternoon of August 7th. It will be seen as partial all over the country, and as total throughout Iowa, Central Illinois, Southern Indiana, Kentucky, and North Carolina. Moreover, as the sun will be nearly at its greatest distance from the earth and the moon at its least, the obscuration will last a longer time than usual.

The chief points of popular interest in a total solar eclipse, and those also that can be seen by the naked eye, are as follows:—

1. The changes in the color of the sky and the clouds, and in the colors and shades of the distant landscape, and also of near objects. 2. The approach and retreat of the dark shadow, which may be stated approximately to be at the rate of a mile a second. 3. The degree of darkness during the totality,

its effect upon animals and plants, and whether stars can be seen; and if so, how many, what stars, and of what color. 4. The corona, or halo of light, which surrounds the moon, and which usually appears three or four seconds previous to the total extinction of the sun's light and continues visible for about the same interval after its reappearance. In general, it may be compared to the nimbus commonly painted around the heads of the saints. To the naked eye, the corona appears to start out from the dark body of the moon just at the moment of total eclipse. It is the most startling and impressive incident of the eclipse,—the climax of the whole phenomenon,—and perhaps the most thrilling effect in nature. 5. The rose-colored projections, which appear around the margin of the moon's disk, are often (though not always) visible even to the naked eye. 6. The sphericity of the moon, which has sometimes been seen projected upon the bright sky; also the effect of the moon's hanging out in the sky between the earth and the sun, and sometimes apparently very near the former. 7. The moments of the four contacts should be noted by all who have even small glasses and who can obtain the correct time, and should be communicated to Professor Stephen Alexander of Princeton, N. J., who is the chairman of the Committee on this eclipse, appointed by the National Academy of Sciences. For a full list of points to be observed, see an elaborate paper by the same gentleman in the Coast Survey Report for 1860.

Solar eclipses always begin on the west side of the sun and terminate on the east side; that is, the moon moves over the sun from west to east. The whole duration of a total eclipse is about two hours, and that of the total phase two or three minutes. There is no premonition of a solar eclipse, the moon (whose dark side toward us) being invisible in the intensely brilliant beams of the sun, until her eastern limb (or rim) actually touches his western limb. After a half an hour, if the sky be clear, the light begins to alter. Gradually the cheerful and vigorous brilliancy of summer will seem to change into something like the feeble and ineffectual radiance occasionally noticeable in winter. Mrs. Airy, wife of the Astronomer Royal, who was one of her husband's party in Spain, thus describes a still deeper phase of an eclipse: "A gloominess gradually crept over the whole scene as if a storm were coming on. The southern mountains beyond the Ebro began to stand up strangely black. Then a sickly green hue overspread the whole nearer landscape. A peculiarly mournful sighing wind, cold and strong, began to rise, as if from among the large old trees beneath us on the north side of the hill. The butterflies disappeared, but the swift continued on the wing. These appearances grew more and more intense, and all 'instructions' were totally forgotten in the excitement of the moment. It became very cold, and I was glad to wrap myself in a large Scotch plaid."

Half a minute before totality Lieutenant Gillis speaks of seeing the purplish-black moon "for the first time in my life in its true form,—a sphere and not a disk. At the moment of totality, beads of golden and ruby-colored light flashed almost entirely round the moon." This flickering band broke up suddenly, and the rose-colored protuberances attracted Lieutenant Gillis's attention so strongly that he forgot the corona and lost the beat of the chronometer. Indeed, the most experienced observers are often thrown off their guard at the moment of inner contact. Thus, Mr. Baily says of the eclipse of 1842: "I had noted down, on paper, the time of my chronometer, and was in the act of counting the seconds in order to ascertain the time of inner contact, when I was astounded by a tremendous burst of applause from the streets below, and at the same moment was electrified at the sight of one of the most brilliant and splendid phenomena that can well be imagined. For, at that instant, the dark body of the moon was suddenly surrounded with a corona, or kind of bright glory, similar in shape and relative magnitude to that which painters draw round the heads of saints, and which by the French is designated an *aurole*. Pavia contains many thousand inhabitants, the major part of whom were at this early hour walking about the streets and squares, or looking out of windows, in order to witness this long-talked-of phenomenon; and when the total obscuration took place, which was instantaneous, there was an universal shout from every observer, which 'made the welkin ring'; and for the moment withdrew my attention from the object with which I was immediately occupied." The observers of the eclipse of 1860 in Labrador saw "the dark shadow advance from the west with a frightful rapidity, and then pass over. It looked like a dark column or very dark cloud. The tint of the sky during the totality was of an intense blue. The dark moon appeared to hang out in space between us and the sun. A gloomy unearthly light fell upon all objects, impressing one with the idea that some fearful calamity was about to happen. The wind, which had been blowing in gusts, now sank, and a death-like stillness prevailed. A little solitary bird poured forth a melancholy song, and then the stillness appeared even greater than before. Capella and other stars were seen."

In Spain, just before the totality, Mr. Airy saw through the telescope "while the white sun was still shining, two red prominences of great size

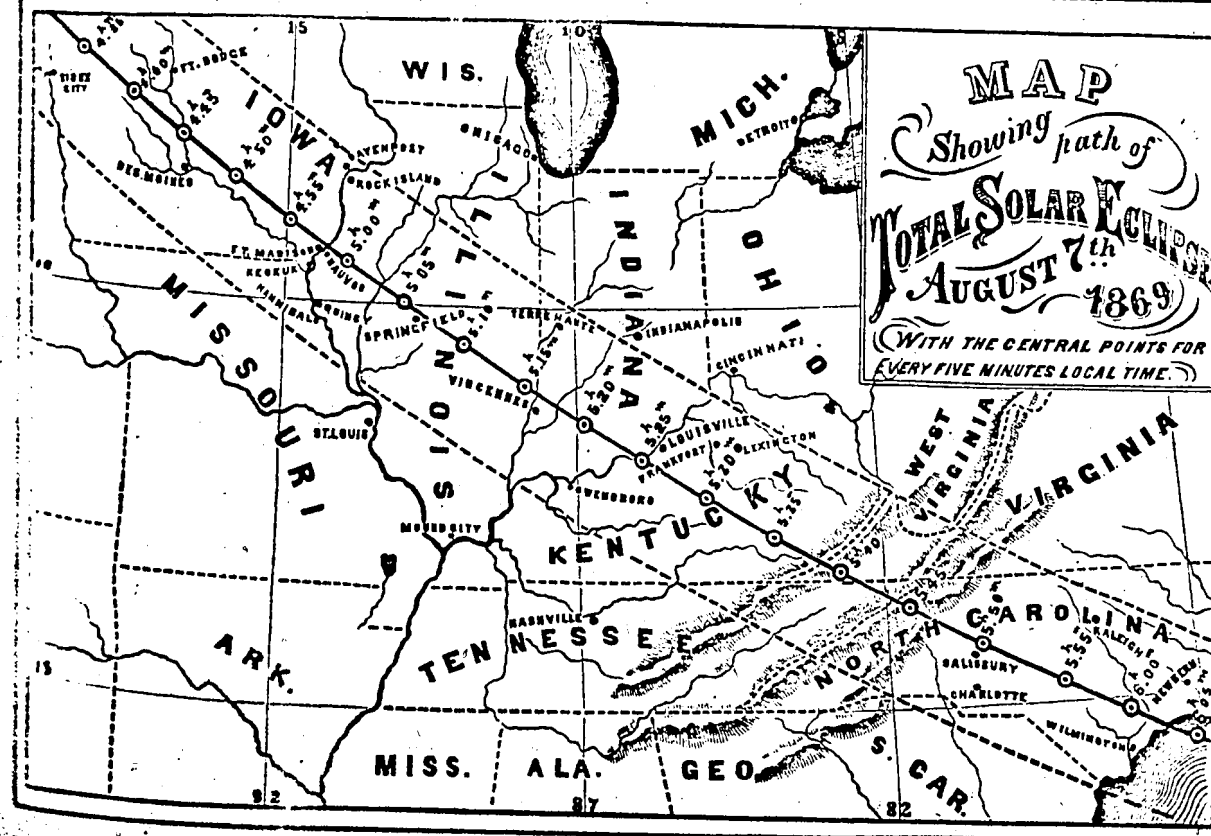
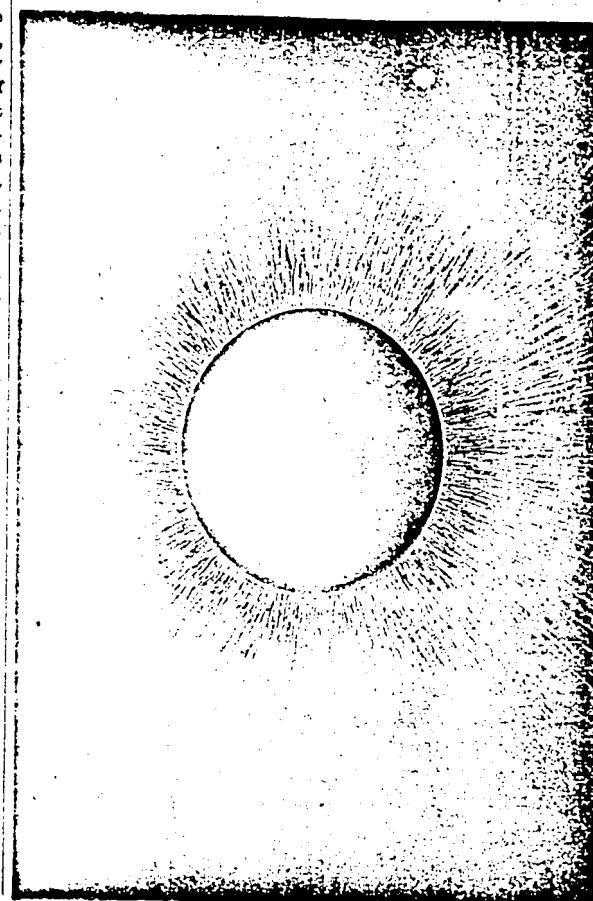
and one double floating red cloud. The white corona formed round the moon all at once; and the moon was seen complete, with dazzling sun, brilliant corona, and brilliant prominences." To the naked eye, however, the crescent had diminished to a thread. "The gloom," continues Mr. Airy, "was everywhere intense. I was particularly struck with the moaning of the wind among the old forest-trees beneath me. The swifts had disappeared. A deeper gloom filled the sky in the northwest, and came rapidly on. The moment of totality had come; the whole air was at once filled with darkness, yet it was darkness through which mountain and valley could be distinctly seen. For a moment we seemed to be in the midst of a streaky shower of smoke or fine dust, which, however, was perfectly clear, and which could not be felt. The range of southern hills was of an inky black, while the sky beyond them was an intense golden orange. My shadow on the ground was quite black and sharp as in the clearest moonlight." The corona was a bright radiating glory, its appearance made very singular from the projection of four or five brilliant beams at about equal intervals, far beyond the width of all the rest. I could not, with the unaided eye, see the red prominences. At the reappearance of the sun "we saw the dark shadow distinctly sweeping away along the valley to the southeast, a path of darkness, and the clear daylight breaking out behind it." The darkness of a total eclipse is doubtless singular both in tint and in degree to that of a very heavy thunder-storm.

Of the original of our cut, which has never been engraved before, an eye-witness of the eclipse it represents says: "With this I send you, for the American Philosophical Society, a painting, intended to represent the central eclipse of the sun on the 16th of June last. It is executed by Mr. Kara Ames, an eminent portrait-painter of this place, and gives, I believe, a true representation of that grand and beautiful phenomenon as can be artificially expressed. The edge of the moon" (he mistakes, perhaps, the inner part of the corona for the outer edge of the moon) "was strongly illuminated, and had the brilliancy of polished silver. No common colors could express this; I therefore directed it to be attempted, as you will see, by a raised silvered rim, which, in a proper light, produces tolerably well the required effect. As no verbal description can give anything like a true idea of the sublime spectacle with which man is so rarely gratified, I thought this painting would not be an unwelcome present to the society, or an improper article to be preserved among its collection of subjects for philosophical speculation. But, in order to have a proper conception of what is intended to be represented, you must transfer your ideas to the heavens, and imagine, at the departure of the last ray of the sun, in its retreat behind the moon, an awful gloom immediately diffused over the face of nature; and round a dark circle near the zenith, an immense radiated glory, like a new creation, in a moment bursting on the sight, and for several minutes fixing the gaze of man in silent amazement."

The tables upon the next page require no explanation. As the longitudes

of places in the West are mostly quite uncertain, the positions assumed have been given. By means of Tables III. and IV. the outline of the shadow can be laid down on a map, and the times of inner contacts for other places estimated.

TOTAL ECLIPSE OF 1869, AS SEEN AT ALBANY, N. Y.



TABLES OF ECLIPSE OF AUGUST 7, 1869.

TABLE I.—Phenomenal Phases, Calculated by means of the Observatory of
Rev. Thomas Hill, D. D., LL. D., President of Harvard College.

Place.	Latitude.	Diff. of Time from Wash.	Beginning of Eclipse.	Middle of Eclipse.	End of Eclipse.	No. of Days of Eclipse.	Side of Sun Eclipse.
Sitka, Alaska	57° 0' N.	+3 58	11 40 A.M.	0 59 P.M.	2 10 P.M.	11	N.
San Francisco, Cal.	37 50 N.	+3 58	1 22 P.M.	2 15 P.M.	3 40 P.M.	6	N.
St. Louis, Mo.	38 40 N.	+3 58	4 37 P.M.	5 5 P.M.	6 32 P.M.	near 12	N.
Springfield, Ill.	39 50 N.	+3 58	4 47 P.M.	5 7 P.M.	6 38 P.M.	total.	N.
Chicago, Ill.	41 50 N.	+3 58	4 59 P.M.	5 13 P.M.	6 38 P.M.	11	S.
New Orleans, La.	30 0 N.	+3 58	4 20 P.M.	5 15 P.M.	6 11 P.M.	9	N.
Cincinnati, O.	39 10 N.	+3 58	4 29 P.M.	5 23 P.M.	6 23 P.M.	near 12	N.
Detroit, Mich.	42 20 N.	+3 58	4 31 P.M.	5 32 P.M.	6 24 P.M.	11	S.
Cleveland, O.	41 30 N.	+3 58	4 37 P.M.	5 33 P.M.	6 20 P.M.	11	S.
Pittsburg, Penn.	40 30 N.	+3 58	4 43 P.M.	5 40 P.M.	6 43 P.M.	11	S.
Buffalo, N. Y.	42 50 N.	+3 58	4 47 P.M.	5 49 P.M.	6 38 P.M.	10	S.
Charleston, S. C.	32 50 N.	+3 58	4 59 P.M.	5 55 P.M.	6 49 P.M.	11	S.
Washington, D. C.	38 50 N.	+3 58	5 2 P.M.	6 0 P.M.	6 53 P.M.	total.	N.
Wilmington, N. C.	34 10 N.	+3 58	5 4 P.M.	6 3 P.M.	7 0 P.M.	11	S.
Baltimore, Md.	39 20 N.	+3 58	5 7 P.M.	6 5 P.M.	6 53 P.M.	9	S.
Montreal, Canada	45 30 N.	+3 58	6 7 P.M.	6 8 P.M.	6 56 P.M.	11	S.
Philadelphia, Penn.	40 0 N.	+3 58	6 8 P.M.	6 8 P.M.	6 57 P.M.	11	S.
Albany, N. Y.	42 40 N.	+3 58	6 10 P.M.	6 9 P.M.	6 58 P.M.	10	S.
New York, N. Y.	40 40 N.	+3 58	6 11 P.M.	6 10 P.M.	7 0 P.M.	10	S.
Quebec, Canada	46 50 N.	+3 58	6 15 P.M.	6 13 P.M.	7 1 P.M.	9	S.
Boston, Mass.	42 23 N.	+3 58	6 16 P.M.	6 14 P.M.	7 8 P.M.	10	S.
Portland, Maine	43 40 N.	+3 58	6 24 P.M.	6 21 P.M.	7 8 P.M.	9	S.

TABLE II.—Showing the times of Beginning and Ending of the Total Phase
for several places in the United States.

Place.	Latitude taken.	Longitude taken.	Time of Beginning.	Time of Ending.	Duration of Total Eclipse.	Side of Central Line.
Logan, Neb.	42 25	W. 19 31	4 31.1	4 33.5	2.4	South.
Decatur, " "	41 58	W. 19 17	4 33.6	4 35.1	1.5	South.
Lincoln, Iowa	43 1	W. 19 39	4 29.8	4 32.3	2.5	South.
O'Brien, " "	43 3	W. 19 51	4 32.8	4 35.8	3.0	South.
Sioux City, " "	42 29	W. 19 39	4 30.5	4 32.9	2.4	South.
Algona, " "	43 0	W. 17 27	4 39.3	4 41.8	2.5	North.
Boonesboro, " "	42 8	W. 17 0	4 42.5	4 45.5	3.0	North.
Cedar Falls, " "	42 34	W. 15 21	4 49.9	4 50.8	0.9	North.
Des Moines, " "	41 38	W. 19 50	4 44.1	4 47.0	2.9	South.
Grinnell, " "	41 47	W. 15 47	4 48.4	4 51.2	2.8	North.
Marengo, " "	41 46	W. 15 18	4 50.8	4 53.8	3.0	North.
Cedar Rapids, " "	42 1	W. 14 62	4 54.5	4 54.8	1.8	North.
Iowa City, " "	41 39	W. 14 39	4 53.5	4 53.2	2.4	North.
Des Moines, " "	41 4	W. 10 64	4 45.1	4 47.1	2.0	South.
Madison, " "	41 19	W. 15 47	4 49.2	4 52.1	2.9	South.
Washington, " "	41 17	W. 14 48	4 53.6	4 56.8	3.2	North.
Muscatine, " "	41 28	W. 14 4	4 56.7	4 58.8	2.1	North.
Burlington, " "	40 50	W. 14 10	4 56.9	4 59.9	3.0	North.
Kokuk, " "	40 21	W. 14 30	4 56.4	4 59.0	2.7	South.
Rock Island, Ill.	41 28	W. 13 33	4 59.8	5 0.8	1.0	North.
Peoria, " "	40 39	W. 12 38	5 4.0	5 6.1	2.1	North.
Macomb, " "	40 24	W. 13 45	4 59.4	5 2.8	2.9	North.
Bloomington, " "	40 27	W. 11 59	5 7.3	5 9.4	2.1	North.
Quincy, " "	39 55	W. 14 28	4 57.4	4 59.7	2.3	South.
Decatur, " "	39 51	W. 12 0	5 7.7	5 10.4	2.7	North.
Springfield, " "	39 49	W. 12 42	5 4.9	5 7.7	2.8	South.
Jacksonville, " "	39 48	W. 12 30	5 4.8	5 7.6	2.8	North.
Shelbyville, " "	39 24	W. 13 19	5 2.3	5 5.1	2.8	South.
Vandalia, " "	39 24	W. 11 49	5 9.2	5 12.0	2.8	South.
Alton, " "	38 56	W. 12 9	5 8.9	5 11.2	2.3	South.
Terre Haute, Ind.	38 31	W. 13 11	5 5.5	5 8.2	2.7	South.
Vincennes, " "	39 31	W. 10 23	5 15.1	5 17.4	2.3	North.
Columbus, " "	39 46	W. 10 29	5 15.9	5 18.8	2.9	South.
Madison, " "	39 14	W. 8 50	5 22.8	5 24.8	1.5	North.
New Harmony, " "	38 45	W. 8 18	5 25.4	5 27.3	1.9	North.
Evansville, " "	38 9	W. 10 53	5 15.5	5 17.6	2.0	South.
Louisville, Ky.	38 13	W. 8 27	5 25.1	5 27.6	2.5	North.
Shelbyville, " "	38 18	W. 8 6	5 26.6	5 29.0	2.4	North.
Frankfort, " "	38 14	W. 7 37	5 23.8	5 31.0	2.3	North.
Lexington, " "	38 6	W. 7 15	5 30.5	5 32.7	2.2	North.
Bardonia, " "	37 41	W. 8 20	5 26.8	5 28.9	2.1	South.
Danville, " "	37 43	W. 7 33	5 29.5	5 42.0	2.5	North.
Piketon, " "	37 28	W. 6 13	5 40.0	5 41.6	1.6	North.
Bowling Green, " "	37 2	W. 9 17	5 24.9	5 24.9	.0	South.
Somers, " "	37 8	W. 7 18	5 31.7	5 34.1	2.4	South.
Burkeville, " "	33 41	W. 8 10	5 29.5	5 30.5	1.0	South.
Abingdon, Va.	38 41	W. 4 49	5 42.4	5 44.7	2.3	North.
Wytheville, " "	38 54	W. 4 0	5 45.7	5 47.8	1.6	North.
Bristol, Tenn.	36 34	W. 5 11	5 40.9	5 43.2	2.3	North.
Greenville, " "	35 4	W. 5 51	5 39.5	5 41.8	1.8	South.
Knoxville, " "	35 49	W. 6 55	5 38.4	5 38.4	.0	South.
Morgantown, N. C.	35 46	W. 4 43	5 44.1	5 47.1	2.0	South.
Statesville, " "	35 47	W. 8 57	5 47.3	5 49.5	2.2	South.
Ashville, " "	35 34	W. 5 30	5 41.8	5 48.0	1.2	South.
Lexington, " "			5 50.4	5 52.8	2.2	North.
Wilmington, " "			5 57.4	5 58.5	1.1	South.
Newbern, " "	34 14	W. 0 58	6 1.7	6 4.8	1.9	South.
	34 42	W. 0 22	6 5.8	6 8.0	2.2	North.

* The latitude and longitude have been taken from Mitchell's School Atlas.
† The latitude and longitude have been taken from Lippincott's Gazetteer.
‡ The longitude is taken from Lippincott; the latitude from Mitchell.
§ Indicates that the calculations are only approximate, owing to the sun's being near the horizon.
|| The latitude and longitude are from Coast Survey Reports.

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TABLE III.—Giving the Latitudes and Longitudes of Points upon the Central Line of the Eclipse and the Extreme Dimensions of the Shadow in successive minutes of Washington time.

Washington Time. P. M.	Central Points.		Azimuth of Sun at Central Points.	Greatest Radius of Shadow from Central Parts.		Radius of circular section of Cone in Geographi- cal Miles.
	Latitude.	Longitude.		Away from Sun.	Towards the Sun.	
h. m.						
50	42 53	18 46w.	88 57	1 39	1 35	45
51	42 29	17 58	88 15	1 42	1 37	44
52	42 5	17 10	88 50	1 43	1 38	44
53	41 40	16 20	89 44	1 44	1 40	44
54	41 14	15 28	90 24	1 43	1 42	44
55	40 48	14 35	91 38	1 43	1 47	44
56	40 21	13 39	92 35	1 47	1 50	43
57	39 53	12 41	93 30	2 1	1 54	43
58	39 24	11 39	94 30	2 5	1 58	43
59	38 54	10 34	95 30	2 14	2 8	43
60	38 23	9 26	96 40	2 18	2 7	43
1	37 50	8 12	97 33	2 22	2 16	42
2	37 14	6 52	98 33	2 44	2 25	42
3	36 37	5 22	99 43	3 8	2 35	41
4	35 56	3 44	101 0	3 30	2 50	41
5	35 10	1 50w.	102 19	4 22	3 12	40
6	34 16	0 32s.	104 22	6 44	3 42	40
7	33 2	8 57s.	106 6	Imaginary.	4 68	39

TABLE IV.—Giving approximate Latitudes and Longitudes of Points upon the Edge of the Total Eclipse, and of Points at which the Total Phase lasts one and two minutes.

Washington Mean Time of First Inner Contact.	North of Central Line.						South of Central Line.					
	0 minutes.		1 minute.		2 minutes.		0 minutes.		1 minute.		2 minutes.	
	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.	Lat.	Long.
5 50	48 20	13 42	43 7	16 36	42 49	15 33	42 28	20 33	42 16	20	6 42	9 19
5 51	42 55	16	42 40	15 43	42 22	15 41	42 4	19 50	41 53	19	41	47 15
5 52	42 27	15	42 14	14 54	41 57	14 54	41 41	19	41 50	18 55	41	22 17
5 53	42 3	14	41 51	14 1	41 30	14 2	41 16	18	41 41	18 17	41	57 15
5 54	41 38	13	41 22	13 8	41 8	13 5	40 51	17	41 23	40	16 54	40 22 16
5 55	41 9	12	40 54	12 8	40 37	12 6	40 20	16	40 35	40	15 16	40 51 5
5 56	40 41	11	40 27	11 11	40 7	11 9	40 2	15	40 39	40	15 5	39 21 3
5 57	40 12	10	39 56	10 5	39 38	10 11	39 26	14	39 39	21	14	38 12 13
5 58	39 40	9	39 23	9 21	38 59	9 3	38 8	13	39 23	14	13	37 43 12
5 59	39 8	8	38 52	8 48	38 29	7 46	38 8	12	38 53	12	12	36 54 10
6 0	38 34	6	38 17	6 38	37 54	6 37	37 8	10	38 27	11	11	36 23 9
6 1	37 58	5	37 37	5 37	37 16	5 13	37 8	9	37 40	10	10	35 47 8
6 2	37 20	4	37 1	4 38	36 38	3 51	37 8	8	37 21	9	9	35 22 6
							36 56	6	36 15	7	7	

TIDES.

To find the time of high tide, enter the following table* at the top with the name of the place, and at the side with the hour of the moon's southing found in the calendar, and in the body of the table will be found a number which, added to the time of the moon's southing, will give the time of high tide.

Time of Moon's Southing.	Boston, Mass.	New York, N. Y.	Philadelphia, Penn.	Old Pt. Comfort, Va.	Baltimore, Md.	Smithville, N. C.	Charleston, S. C.	Fort Pulaski, Savannah, Ga.	Key West, Fla.	San Francisco, Cal.
h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
0 0	11 38	8 20	1 31	6 55	6 47	7 25	7 38	7 20	9 23	11 1
0 30	11 33	8 15	1 23	6 49	6 42	7 21	7 33	7 15	9 18	11 0
1 0	11 28	8 10	1 15	6 43	6 37	7 16	7 27	7 10	9 13	10 55
1 30	11 24	8 10	1 21	6 40	6 34	7 13	7 24	7 07	9 10	10 50
2 0	11 20	8 6	1 18	6 36	6 30	7 10	7 21	7 04	9 07	10 45
2 30	11 16	8 0	1 14	6 32	6 26	7 6	7 17	7 01	9 04	10 40
3 0	11 12	7 55	1 11	6 28	6 22	7 3	7 14	6 58	9 01	10 35
3 30	11 10	7 52	1 8	6 25	6 19	7 0	7 11	6 55	8 58	10 30
4 0	11 7	7 52	1 6	6 20	6 17	7 0	7 0	6 53	8 55	10 25
4 30	11 6	7 52	1 3	6 21	6 10	7 0	7 0	6 53	8 55	10 25
5 0	11 6	7 53	1 0	6 23	6 10	7 0	7 0	6 53	8 55	10 25
5 30	11 9	7 56	0 58	6 26	6 13	7 0	7 0	6 53	8 55	10 25
6 0	11 13	7 59	0 59	6 32	6 15	7 0	7 0	6 53	8 55	10 25
6 30	11 19	8 5	1 1	6 39	6 19	7 0	7 0	6 53	8 55	10 25
7 0	11 25	8 11	1 7	6 46	6 22	7 0	7 0	6 53	8 55	10 25
7 30	11 32	8 17	1 15	6 53	6 29	7 0	7 0	6 53	8 55	10 25
8 0	11 38	8 23	1 23	7 0	6 34	7 0	7 0	6 53	8 55	10 25
8 30	11 43	8 27	1 29	7 0	6 39	7 0	7 0	6 53	8 55	10 25
9 0	11 47	8 33	1 34	7 0	6 42	7 0	7 0	6 53	8 55	10 25
9 30	11 48	8 34	1 39	7 0	6 44	7 0	7 0	6 53	8 55	10 25
10 0	11 49	8 35	1 44	7 0	6 45	7 0	7 0	6 53	8 55	10 25
10 30	11 49	8 35	1 49	7 0	6 45	7 0	7 0	6 53	8 55	10 25
11 0	11 49	8 35	1 54	7 0	6 45	7 0	7 0	6 53	8 55	10 25
11 30	11 49	8 35	1 59	7 0	6 45	7 0	7 0	6 53	8 55	10 25

beginning of a white space shows that sunrise takes place. The table of light is constructed for New York; but it will serve for any part of the country, if we bear in mind that twilight lasts longer in more northerly latitudes, and not so long in more southerly ones.

ECLIPSES.

In the year 1869 two eclipses will be visible in the United States,--a partial eclipse of the moon and a total eclipse of the sun.

The eclipse of the moon takes place on January 27th. The magnitude is 458/1000 of the moon's diameter, the northern part of the moon being eclipsed. The eclipse begins at the northeastern part of the moon, and ends at the northwestern part. It is noticeable that, on the Sierra Nevada, it would (owing to refraction) be possible to see a portion of the moon in eclipse while a portion of the sun is above the horizon.

The following table exhibits the times of the different phases for several places.

//SEE TABLE, PAGE 62, IN XEROXED COPY.//

A total eclipse of the sun is not only one of the most imposing spectacles of nature, but also one of the most important of astronomical phenomena. Although such an eclipse occurs nearly every year somewhere on the earth, yet the area within which it can be observed is so small that it happens to few persons to witness one in the course of a lifetime. There have been only two that were visible in any large part of the United States since the beginning of the present century, namely, those of 1806 and of 1834. Hence, a total eclipse, whose path lies through a large and thickly settled portion of our country, is an event whose interest cannot be exaggerated. Such an eclipse will take place in the United States on the afternoon of August 7th. It will be seen as partial all over the country, and as total throughout Iowa, Central Illinois, Southern Indiana, Kentucky, and North Carolina. Moreover, as the sun will be nearly at its greatest distance from the earth and the moon at its least, the obscuration will last a longer time than usual.

The chief points of popular interest in a total solar eclipse, and those also that can be seen by the naked eye, are as follows:--

1. The changes in the color of the sky and the clouds, and in the colors and shades of the distant landscape, and also of near objects.
2. The approach and retreat of the dark shadow, which may be stated approximately to be at the rate of a mile a second.
3. The degree of darkness during the totality, its effect upon animals and plants, and whether stars can be seen; and if so, how many, what stars, and of what color.
4. The corona, or halo of light, which surrounds the moon, and which usually appears three or four seconds previous to the total extinction of the sun's light and continues visible for about the same interval after its re-appearance. In general, it may be compared to the nimbus commonly painted around the heads of the saints. To the naked eye, the

corona appears to start out from the dark body of the moon just at the moment of total eclipse. It is the most startling and impressive incident of the eclipse,--the climax of the whole phenomenon,--and perhaps the most thrilling effect in nature. 5. The rose-colored projections, which appear around the margin of the moon's disk, are often (though not always) visible even to the naked eye. 6. The sphericity of the moon, which has sometimes been seen projected upon the bright sky; also the effect of the moon's hanging out in the sky between the earth and the sun, and sometimes apparently very near the former. 7. The moments of the four contacts should be noted by all who have even small glasses and who can obtain the correct time, and should be communicated to Professor Stephen Alexander of Princeton, N.J., who is the chairman of the Committee on this eclipse, appointed by the National Academy of Sciences. For a full list of points to be observed, see an elaborate paper by the same gentleman in the Coast Survey Report for 1860.

Solar eclipses always begin on the west side of the sun and terminate on the east side; that is, the moon moves over the sun from west to east. The whole duration of a total eclipse is about two hours, and that of the total phase two or three minutes, more or less. There is no premonition of a solar eclipse, the moon (whose dark side is toward us) being invisible in the intensely brilliant beams of the adjacent sun, until her eastern limb (or rim) actually touches his western limb. After a half an hour, if the sky be clear, the light begins to alter. Gradually the cheerful and vigorous brilliancy of summer will seem to change into something like the feeble and ineffectual radiance occasionally noticeable in winter. Mrs. Airy, wife of the Astronomer Royal, who was one of her husband's party in Spain, thus describes a still deeper phase of an eclipse: "A gloominess gradually crept over the whole scene as if a storm were coming on. The southern mountains beyond the Ebro began to stand up strangely black. Then a sickly green hue overspread the whole nearer landscape. A peculiarly mournful sighing wind, cold and strong, began to rise, as if from among the large old trees beneath us on the north side of the hill. The butterflies disappeared, but the swift continued on the wing. These appearances grew more and more intense, and all 'instructions' were totally forgotten in the excitement of the moment. It became very cold, and I was glad to wrap myself in a large Scotch plaid."

Half a minute before totality Lieutenant Gillis speaks of seeing the purplish-black moon "for the first time in my life in its true form,--a sphere and not a disk. At the moment of totality, beads of golden and ruby-colored light flashed almost entirely round the moon." This flickering band broke up suddenly, and the rose-colored protuberances attracted Lieutenant Gillis's attention so strongly that he forgot the corona and lost the beat of the chronometer. Indeed, the most experienced observers are often thrown off their guard at the moment of inner contact. Thus, Mr. Baily says of the eclipse of 1842: "I had noted down, on paper, the time of my chronometer, and was in the act of counting the seconds in order to ascertain the time of inner contact, when I

was astounded by a tremendous burst of applause from the streets below, and at the same moment was electrified at the sight of one of the most brilliant and splendid phenomena that can well be imagined. For, at that instant, the dark body of the moon was suddenly surrounded with a corona, or kind of bright glory, similar in shape and relative magnitude to that which painters draw round the heads of saints, and which by the French is designated an aureole. Pavia contains many thousand inhabitants, the major part of whom were at this early hour walking about the streets and squares, or looking out of windows, in order to witness this long-talked-of phenomenon; and when the total obscuration took place, which was instantaneous, there was an universal shout from every observer, which 'made the welkin ring'; and for the moment withdrew my attention from the object with which I was immediately occupied." The observers of the eclipse of 1860 in Labrador saw "the dark shadow advance from the west with a frightful rapidity, and then pass over. It looked like a dark column or very dark cloud. The tint of the sky during the totality was of an intense blue. The dark moon appeared to hang out in space between us and the sun. A gloomy unearthly light fell upon all objects, impressing one with the idea that some fearful calamity was about to happen. The wind, which had been blowing in gusts, now sank, and a death-like stillness prevailed. A little solitary bird poured forth a melancholy song, and then the stillness appeared even greater than before. Capella and other stars were seen."

In Spain, just before the totality, Mr. Airy saw through the telescope, "while the white sun was still shining, two red prominences of great splendor and one double floating red cloud. The white corona formed round the moon all at once; and the moon was seen complete, with dazzling sun, brilliant corona, and brilliant prominences." To the naked eye, however, the crescent had diminished to a thread. "The gloom," continues Mr. Airy, "was everywhere intense. I was particularly struck with the moaning of the wind among the old forest-trees beneath me. The swifts had disappeared. A deeper gloom filled the sky in the northwest, and came rapidly on. The moment of totality had come; the whole air was at once filled with darkness, yet it was darkness through which mountain and valley could be distinctly seen. For a moment we seemed to be in the midst of a streaky shower of smoke or fine dust, which, however, was perfectly clear, and which could not be felt. The range of southern hills was of an inky black, while the sky beyond them was an intense golden orange. My shadow on the ground was quite black and sharp as in the clearest moonlight." The corona was a bright radiating glory, its appearance made very singular from the projection of four or five brilliant beams at about equal intervals, far beyond the width of all the rest. I could not, with the unarm'd eye, see the red prominences." At the reappearance of the sun "we saw the dark shadow distinctly sweeping away along the valley to the southeast, a path of darkness, and the clear daylight breaking out behind it." The darkness of a total eclipse is doubtless similar both in tint and in degree to that of a very heavy thunder-storm.

Of the original of our cut, which has never been engraved before, an eye-witness of the eclipse it represents says: "With this

I send you, for the American Philosophical Society, a painting, intended to represent the central eclipse of the sun on the 16th of June last. It is executed by Mr. // Ames, an eminent portrait-painter of this place, and gives, I believe, as true a representation of that grand and beautiful phenomenon as can be, artificially expressed. The edge of the moon" (he mistakes, perhaps, the inner part of the corona for the outer edge of the moon) "was strongly illuminated, and had the brilliancy of polished silver. No common colors could express this; I therefore directed it to be attempted, as you will see, by a raised silvered rim, which, in a proper light, produces tolerably well the required effect. As no verbal description can give anything like a true idea of the sublime spectacle with which man is so rarely gratified, I thought this painting would not be an unwelcome present to the society, or an improper article to be preserved among its collection of subjects for philosophical speculation. But, in order to have a proper conception of what is intended to be represented, you must transfer your ideas to the heavens, and imagine, at the departure of the last ray of the sun, in its retreat behind the moon, an awful gloom immediately diffused over the face of nature; and round a dark circle near the zenith, an immense radiated glory, like a new creation, in a moment bursting on the sight, and for several minutes fixing the gaze of man in silent amazement."

The tables upon the next page require no explanation. As the longitudes of places in the West are mostly quite uncertain, the positions assumed have been given. By means of Tables III. and IV. the outline of the shadow can be laid down on a map, and the times of inner contacts for other places estimated.

//SEE PICTURES AND TABLES, PAGES 63 & 64, IN XEROXED COPY.//