ECLIPSE OF THE SUN IN JULY, 1907.

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The form of the moon's path in space, which is the resultant of two motions—the earth's revolution round the sun, and that of the moon round the earth—was shown in an article "How Eclipses Occur," published in the SCIENTIFIC AMERICAN for August 11, 1906.

The motion of the moon is so slow in comparison with that of the earth, that each day the earth traverses a distance equal to three and one-third times the diameter of the moon's orbit. As a consequence, the form of the moon's path projected on the plane of the ecliptic is a curve without inflection; i. e., it is always concave toward the sun.

But the moon's path relative to the earth may be studied without reference to its path relative to the sun, for the same reason that the earth's orbit is usually studied without any reference to the fact that the sun itself is traveling through space.

The eclipses for this year are as follows: January 13, a total eclipse of the sun; January 29, a partial eclipse of the moon; July 10, an annular eclipse of the sun; July 24, a partial eclipse of the moon.

As the diameter of the earth's orbit is three hundred and eighty-nine times that of the moon, it is important to emphasize this great difference in a study of solar and lunar eclipses. The diameters of the orbits of the earth and moon are correctly proportioned in Fig. 1; and in order to compare them within the limits of this page, the moon's orbit is represented by the very small circles at the dates of the eclipses of the sun and moon in July. The diameter of the sun, which is about one and four-fifths the diameter of the moon's orbit, is also correctly proportioned in the drawing. Fig. 1 also represents approximately the relative diameters of the sun and moon, which are very nearly in the same proportion as the diameters of the earth's and moon's orbits.

In an examination of the positions of the earth and moon relative to the sun during the eclipse in July, the moon's orbit is shown in Fig. 2 on a scale large enough to make clear the conditions which result in an eclipse. The plane of the moon's orbit is inclined at an angle of a little over five degrees to the plane of the ecliptic. That part of the orbit which is above the plane of the ecliptic is represented by the heavy line; and the part which is below, by the fine line.

The point N is the ascending node, where the moon's orbit pierces the plane of the ecliptic. The lines joining the ascending and descending nodes with the center of the earth are the intersections of the plane of the moon's orbit with the plane of the ecliptic. Each line slowly changes its direction while the earth is revolving round the sun, i.e., it does not move into parallel positions.

The position of the moon is shown each day from July 8 to the 13th. From the 8th to the 10th she will be below the plane of the ecliptic, and will reach the ascending node on the 10th, but the eclipse will occur before the node is reached, and consequently will be visible in the southern hemisphere. The moon will pass apogee the day before the eclipse (the 9th) and will be very near her maximum distance from the earth. She will therefore subtend an angle which will differ a very little from its minimum value. The sun's apparent diameter will be a little over two minutes greater than the moon's, notwithstanding that the earth will have recently passed aphelion, and the sun's apparent size reduced to almost a minimum. The result will be an annular eclipse visible from a limited area of the earth's surface.

It is noticeable that the seasons for eclipses recur at intervals of about six months, and that two or more eclipses may follow at intervals of about two weeks, when sufficient time has elapsed for the moon to make about one-half her revolution round the earth from one node to the other.

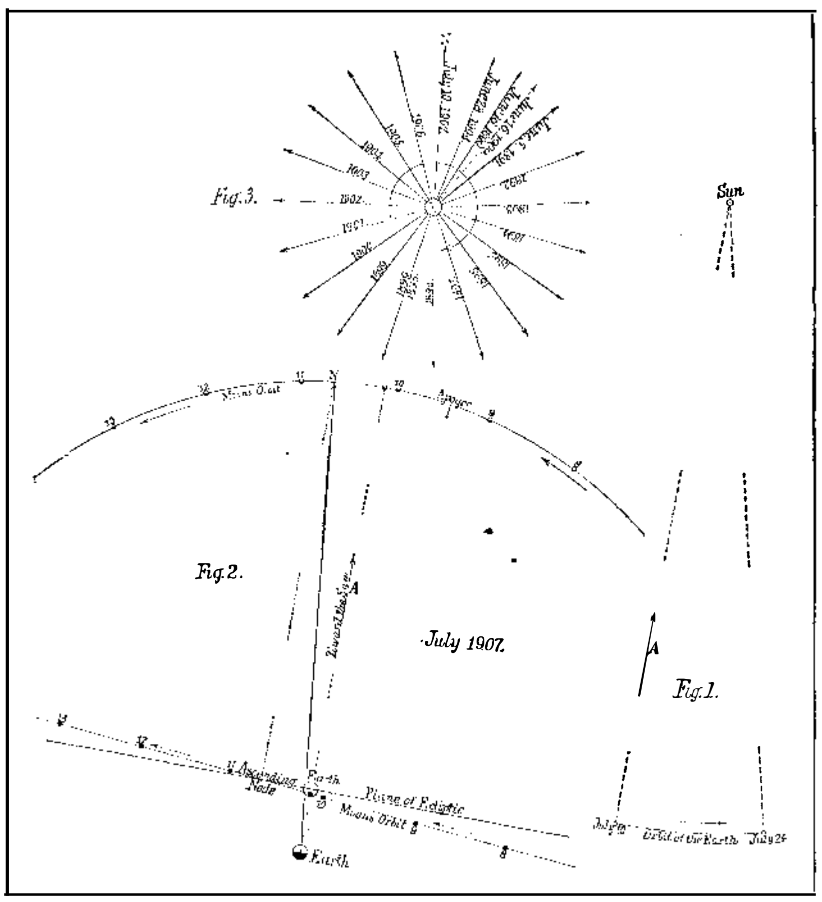
The recurrence of the eclipse seasons at intervals that average a little less than half a year is due to the gradual twisting of the line of nodes. Fig. 3 shows the position of the ascending node at each of the dates attached, from 1890 to 1909, during which period the ascending and descending nodes make a complete revolution in a direction (indicated by the arrow) contrary to the moon's motion in her orbit. The positions of the descending node are omitted to avoid confusion.

One June 16, 1890, the moon passed the ascending node. On that day there was an annular eclipse of the sun. The moon will pass the same node on June 16, 1909. The period of twenty years includes forty-six eclipses of the sun, and thirty of the moon. A lunar appulse occurs three times. The following table gives the dates of eclipses from 1890 to 1909 inclusive, and is arranged to show the effect of the rotation of the line of nodes, which results in advancing the dates of the eclipse seasons. Usually there are two eclipse seasons in the year; but when an eclipse occurs very near the beginning or the end of the year there may be included in that particular year three eclipse seasons. This is illustrated in the years 1898 and 1899. The meaning is obvious. An eclipse season belongs partly to one year and that which immediately follows. December 12, 27, 1898, and January 11, 1899, belong to the same eclipse season. The year 1908 will also include three eclipse seasons.

TABLE.

Eclipses of the Sun and Moon from 1890 to 1909.

1890	June 2, 16	Nov. 25, Dec. 11	
1891	May 23, June 6	Nov. 15, 30	
1892	Apr. 26, May 11	Oct. 20, Nov. 4	
1893	Apr. 15	Oct. 9	
1894	Mar. 20, Apr. 5	Sept. 14, 28	
1895	Mar. 10, 25	Aug. 20, Sept. 3, 18	
1896	Feb. 13, 28	Aug. 8, 22	
1897	Feb. 1	July 29	
1898	Jan. 7, 21	July 3, 18	Dec. 12, 27
1899	Jan. 11	June 7, 22	Dec. 2, 16
1900		May 28, June 12	Nov. 21
1901		May 3, 17	Oct. 27, Nov. 10
1902		Apr. 8, 22, May 7	Oct. 16, 30
1903		Mar. 28, Apr. 11	Sept. 20, Oct. 6
1904		Mar. 16	Sept. 9
1905		Feb. 19, Mar. 5	Aug. 14, 29
1906		Feb. 8, 22	July 20, Aug. 4, 19
1907		Jan. 13, 29	July 10, 24
1908		Jan. 3	June 28	Dec. 7, 22
1909			June 3, 17	Nov. 26, Dec. 12



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Water in the Earth.

In a discourse recently delivered at the Royal Institution in London, in regard to ore deposits and their distribution and depth, Prof. John W. Gregory presents an astonishing view of the condition of water at temperatures above its critical point. It is evidently his opinion that the elements of water are not combined with each other above the critical temperature of liquefaction, for he says: "Water, although its constituents may come from vast depths within the interior, is limited to a depth of perhaps only six or seven times the depth of existing mines. The lower limit is due to the internal heat of the globe. . . . Now water cannot exist at a temperature higher than its critical point, 687 deg. F. . . . At depths below about 37,000 feet the temperature would be above the critical point of water, which therefore could not exist as such. Its elements would be given forth as separate gases from the slowly cooling magma; the gases would rise, and having passed into a zone with a temperature below the critical would combine to form water." The author has confused the critical temperature of liquefaction, 358 deg. C., with the temperature of dissociation of water, which is probably about 2,500 deg. C. The only change which water undergoes at its critical temperature is the loss of its surface where it is in contact with a gas or vapor, no matter how great the pressure may be. If the view set forth in the quoted extract were true, the maximum temperature to be obtained by the combustion of hydrogen and oxygen would be 687 deg. F., which is near the boiling point of mercury.—Chem. News.

Ancient Lenses.

Contrivances for bringing the rays of the sun to a focus in order to produce combustion have been employed almost from time immemorial. A curious proposal bearing on this point is made by Aristophanes in his comedy of the "Clouds." Strepsiades, the hero of the play, is greatly harrassed with debts and has not the wherewithal to pay. He therefore proposes to his master to get a stone at some chemist's shop of the kind with which they kindle fire, and when the clerk is entering the suit, to stand at some distance and melt it out. As the writing tablets then in use were probably thin boards covered with a still thinner coating of wax on which the writing was done with a pointed instrument, it would not require great heat to effect the purpose. Besides, if, as seems to have been the case and custom, burning-glasses were used to kindle fires, they must have been of considerable size even in a country like Greece, where the sun shines very hot most of the year. Moreover, we are told, they were kept in the chemists' shops for this purpose. If by any mishap the sacred fire watched over by the Vestal Virgins in Rome went out, it was rekindled by means of a burning-glass. Polybius, when speaking of the siege of Syracuse by the Romans, B. C. 214, relates that they were unable to take it from the side of the sea because of the engines employed against them by Archimedes, unquestionably the greatest mechanician of the ancient world. Says he: "So true is it that one man and one intellect properly qualified for the particular undertaking is a host in himself and of wonderful efficacy." The Romans were confident that they could take the city "if one man could be got rid of." He might have added with equal truth that when a man appears in a world wholly unprepared to comprehend him, not only are his thoughts neglected, but his discoveries forgotten. The story that Archimedes set the ships of the Romans on fire by means of burning-glasses is not found in any author who lived near his time. Moreover, the captains of the vessels would hardly be so obliging as to hold their vessels stationary in order that the old philosopher might work his will on them. Yet the marvelous feats he accomplished on the same occasion and vouched for by credible witnesses are scarcely less incredible. It may be accepted as certain that Archimedes produced wonderful effects by means of his lenses, whether they were made of glass or of some other material. That the ancients as late as the age of Plutarch knew nothing of spectacles is clear from the negative testimony of this writer, whose works might be superscribed "Concerning All Things and Some Others." In one of his table talks he tries to explain why old people, when reading, hold the book at some distance from the eyes. He finds the reason to lie in Plato's theory of vision, which he also holds. This philosopher maintained, in common with almost all the thinkers of antiquity, that sight is produced by a sort of fluid substance passing from the visible object to the eye, somewhat in the shape of a cone, the eye being the apex. When the organ becomes weakened by age this attenuated substance is too intense to permit normal vision; so in order to weaken it the object must be held farther away. He finds a confirmation of this theory in the habits of those animals that seek their prey by night when their sight is most acute. The fluid emanating from the object is too strong to be properly commingled with the power of vision, as he expresses it, possessed by these animals, but is so weakened and diluted by the surrounding darkness as to enable them to see at their best. This may seem to us very puerile; it ceases to be so when we remember that to this day no one has been able to answer the question, How do we see?—Dr. C. W. Super in Popular Science Monthly.

Completion of One Tube of the Belmont Tunnel.

Engineers walked through the north tube of the Belmont tunnel on May 16 from Manhattan to Long Island City and then returned to the meeting point of the two shafts to celebrate the nominal completion of one of the most remarkable tunnel engineering jobs on record. Shields of the north bores joined about midway between the Man o' War reef in the middle of the river and Long Island City, the connection being made in solid rock.

The north tube will be ready for trains of the New York and Long Island Railroad Company by August 1.

It will be at least two months, according to St. John Clarke, one of the engineers in charge, before connection will be made in the second or southeast tunnel between the reef and Long Island City.