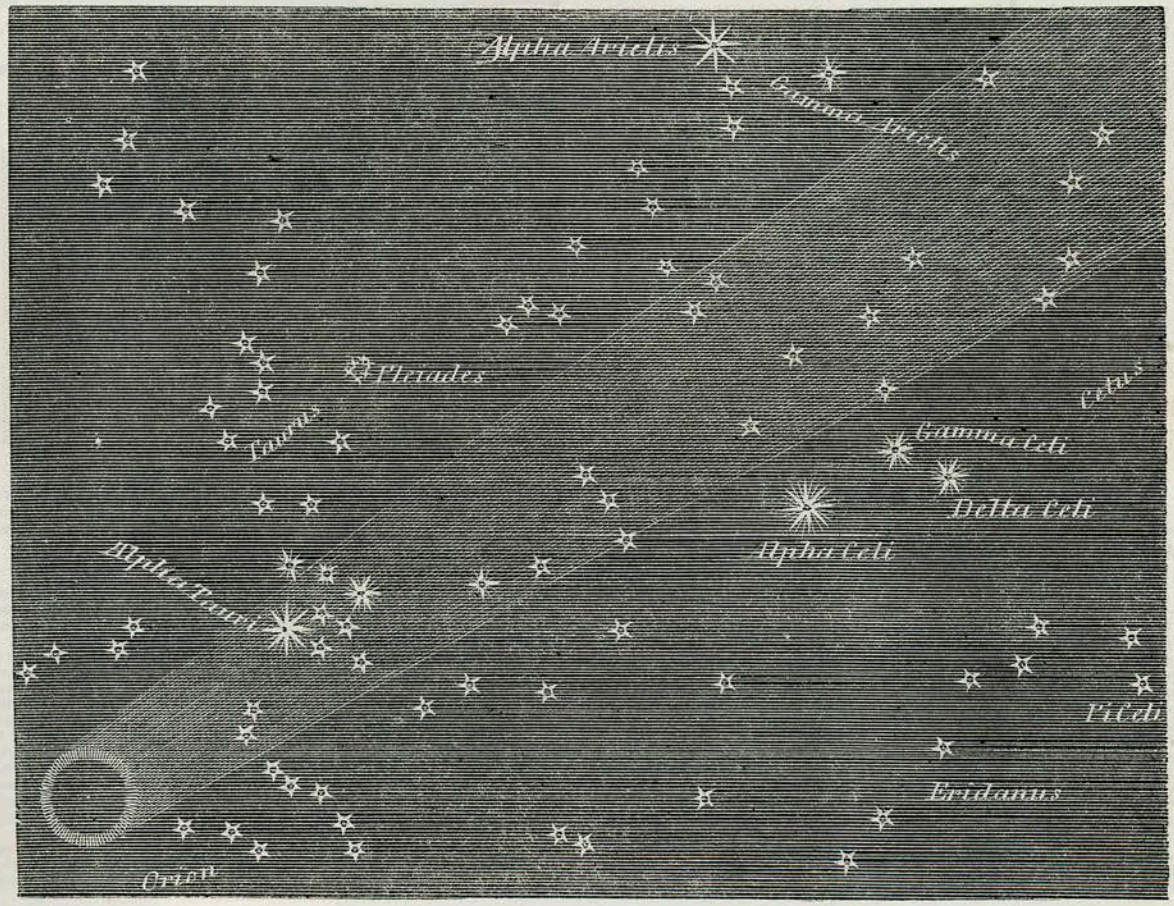
COMETS.

ONE of the greatest comets on record appeared in the month of July, 1264, which remained visible to the end of September of that year. It was first seen during the evenings after sunset, but appeared in its greatest splendour shortly afterwards, when it became visible during the mornings in the N.E., when the tail was perceived long before the comet itself rose above the horizon. The head, we are told, seemed like an obscure and ill-defined star, and the tail passed from this portion of it like expanded flames, stretching forth towards the mid-heavens to a distance of one hundred degrees from the nucleus. This great comet rose later and later every night; the tail became narrower and fainter, and at length finally disappeared. The chroniclers of the time duly mention the various remarkable events which occurred in Europe at this period, and in particular connect the appearance of the comet with the death of Pope Urban, who fell sick (they assert) on the very day when the comet was first seen, and died at the exact time it disappeared—viz., on the last day of September, 1264! This comet was likewise observed in China, and the descriptions agree with the statements of the European historians in respect to its immense dimensions and brightness, although it is rather difficult to reconcile the direction of its motion and its positions in the heavens as given by different observers. Notwithstanding this discordance, the path of the comet round the Sun has been calculated by astronomers from various combinations of those rough observations, and the results agree as well as might be expected. The chroniclers of the time relate that no one then living had ever seen the like of this comet, and very few of those recorded appear to have exceeded it in lustre. Among those which approached or were equal to it in size and brightness we might mention those of the years 1106, 1402, 1456, 1577, 1618, 1668, 1680, 1744, 1769, 1811, and 1843. The tail of the comet of 1618 was 104 degrees in length; that of 1680 90 degrees; that of 1769 was 97 degrees; and in tropical countries the tail of the comet of 1843 was observed to be 65 degrees in length, and the absolute length was 150 millions of miles. The tail of the comet of 1456 was 60 degrees in length—it was an apparition of the celebrated comet of Halley. The comets of 1532, 1744, and 1843 were seen in full sunlight.

In the year 1556 another comet made its appearance, but was not to be compared to that of 1264 in size or brightness, although it is stated to be as large as Jupiter. The tail, however, was only four degrees in length. The colour, according to one observer, was like that of Mars, but it afterwards became quite pale; and another eyewitness states that the end of the tail was always of a leaden hue. This comet remained visible from the beginning of March to the end of April. The celebrated Cardan describes it to be almost as bright as the half-moon, of a red and turbid colour, the tail short and curved like a flame blown aside by wind, and the head of a round shape. From the recorded positions of the comet as laid down in a chart by Fabricius, the path round the Sun has been calculated with much greater precision than in the former case; and during the past year a valuable collection of observations have been discovered by M. Littrow, at Vienna, which were made between Feb. 27 and April 19, 1556. A recalculation of the orbit of this comet as derived from the latter source differs, however, but very little from that previously determined, although it adds very considerably to the trustworthiness of the result. It is much to be desired, although little to be expected, that a similar extended series of observations were discovered of the great comet of 1264.

Judging from the physical appearances of the two comets, the splendour of the first and the ordinary character of the second, but little in common might be expected between them. This, however, is but slight evidence contrasted with the more rigid confirmation afforded by the form, the position, the direction of motion in the immense ellipse described by the comet round the Sun, its least distance from the latter body, and its inclination to the plane of the smaller circle described by our own Earth. No less than five different and distinct elements can be deduced of the path of any comet round the Sun; and, when those five coincide, the evidence is so strong, although circumstantial, that the identity of the two bodies may be regarded as almost certain. It is from these data that Halley concluded that the comets of 1378, 1456, 1531, 1607, and 1682, were one and the same, and predicted its return in 1759 and 1835; and on similar grounds he suspected that the comets of 1264 and 1556 were alike. In the case of the successive apparitions of the former comet, if the similarity of appearance only were taken into account, its imposing aspect in 1456 could hardly be reconciled with its faintness at other times. It might be also imagined that, if the comets of 1264 and 1556 were identical, the period of its revolution round the Sun would be constantly 292 years, and that there would be no error or difficulty in fixing its third appearance in 1848. The cause of this delay in its reappearance is, however, well known, arising from the action of the various bodies scattered round the Sun which retard the motion of the comet in its orbit, and prevent it from arriving at its shortest distance from the Sun at exact intervals of time. Thus, in the successive apparitions of Halley's comet it is found that, between its appearance in 1378 and 1456, 77 years and 212 days had elapsed; whilst between its appearance in 1607 and 1682 only 74 years and 332 days had elapsed. This influence is, however, brought within the range of strict calculation; and this task has lately been executed by M. Bomme, who finds that the return of the comet of 1264 and 1556 to perihelion will be delayed until the year 1858 or 1860 at latest.

Another astronomer (M. Hoek) is of opinion that the two comets of 1264 and 1556 are different bodies, and states that he cannot reconcile the orbit given from the extended series of observations made during 1556 with the Chinese observations of 1264. The path described by the comet



APPEARANCE OF THE GREAT COMET OF 1264.

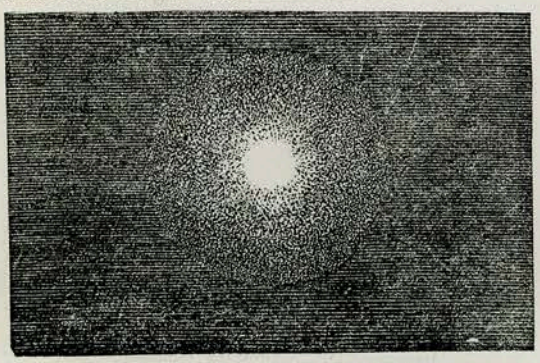
of 1264, as deduced from the Chinese positions, is very different, particularly in the inclination and least distance from the Sun, from that of 1556; and the elements are much more different from one another than the elements of other comets which were never considered to be the same. Nor does he find that this change in the path could have arisen from any planetary disturbances, although the planets Mars and Saturn were near the comet in 1264, though not so near as to cause such great change. He is also of opinion that it is very improbable that the comet of 975 (which is supposed to have been a former appearance of the great comet), and those of 1264 and 1556, are similar bodies. He wishes it to be borne in mind, however, that this result depends on the observations of the tenth and thirteenth centuries, the accuracy of which admits of great doubt.

From the activity displayed in the discovery of comets during the past year, we may feel assured that the return of this comet (if periodical) cannot pass away unnoticed, and that it will be detected as soon as it comes within range of the power of the best telescopes. No less than five comets were discovered during the first nine months of the last year, most of which were very faint, and none of them visible to the naked eye during their whole course.

Comet I. (1857) was discovered by M. D'Arrest on Feb. 23. The nucleus was stellar and well defined, and almost as bright as a star of the seventh magnitude.

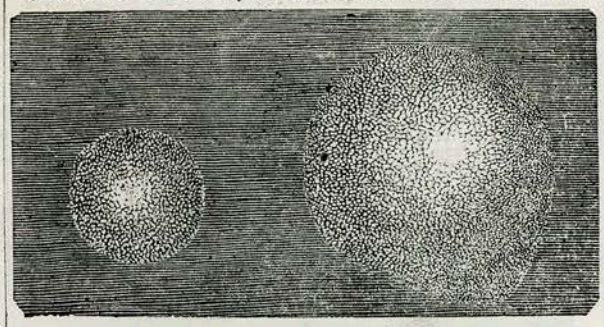
Comet II., 1857, was discovered by M. Bruhn, on March 18, 1857; but was subsequently found to be an appearance of Brorsen's periodical comet, which was detected in 1846. It was faint and ill defined, and did not present any appearance of a nucleus at first.

Comet III. of 1857 was bright and well defined, and, if favourably situated, would have doubtless been seen by the naked eye. It arrived at perihelion on July 18. It was discovered by M. Klinkerfues, at Gottingen.



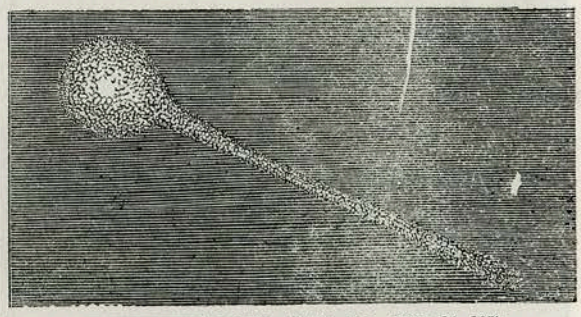
KLINKERFUES' COMET ON JUNE 25, 1857.

Comet IV. of 1857 was very small and faint, and remained visible but for a short period. It was detected by M. Dien, at Paris, in the latter part of July.



DIEN'S COMET ON AUG. 17, 1857. KLINKERFUES' COMET, AT MIDNIGHT, SEPT. 5, 1857.

Comet V. was likewise discovered by M. Klinkerfues, on August 20, and was a conspicuous object in a telescope. On Sept. 5 it was very ill defined in the north-eastern part, and a tail was then suspected. On the night of Sept. 16 a faint tail was first visible, which was long and narrow, and which increased considerably in size until the 20th. This comet bears some resemblance to those of 1790 and 1825.



KLINKERFUES' COMET, AT 8H. P.M., SEPT. 16 1857.

SOLAR ECLIPSE OF MARCH 15, 1858.

THE phenomena attending eclipses of the Sun are numerous and striking, and will, doubtless, be observed with as great care in the eclipse of March as in those which happened in the years 1842 and 1851. The latter eclipses were seen to great advantage, and the various appearances have been described with great minuteness and detail by the astronomers who travelled to those parts of Europe where the eclipses were total and central. Although the eclipse of the present year will scarcely be equal to those in interest (as the obscuration of the Sun's disc will not be altogether complete), yet, as it is the most considerable of any that has happened, or will happen, for many years in the British Islands, a short notice of the phenomena which may be expected to occur may not be misplaced. In the present instance the diameters of the Sun and Moon are so nearly alike that the eclipse will be nearly total; only a very slender thread of light will be seen surrounding the Moon at the instant of greatest darkness; but the duration of this bright ring of light will not exceed thirteen seconds in England, and it has been calculated that the augmentation of the Moon's diameter during the eclipse will cause it to be total in the vicinity of the Island of Madeira. Under the most favourable circumstances of an annular eclipse the Moon may remain on the disc of the Sun for nine minutes and fifty-six seconds; and in a total eclipse the Sun's disc may be completely obscured for a space of six minutes.

The darkness which prevails even during a total eclipse of the Sun is much less than might be expected; and, even when the Sun has been completely hid for a space of between four and five minutes, the light was estimated at the instant of total obscurity to be as great as that of the full Moon. During an annular eclipse the chink of sunshine dispels nearly all darkness. Baily, who observed the annular eclipse of 1836 to considerable advantage, states that the darkness during the period of the annulus was not greater than that caused by a temporary cloud passing over the Sun; the light, however, he remarked, was of a peculiar character, being something like that produced by the Sun shining through a morning mist. The effect of this partial darkness on animals is very remarkable, and similar in all respects to the closing in of night.

One of the most remarkable appearances which occurs during a total eclipse of the Sun is the crown of bright white light which surrounds the dark body of the Moon at the time of total obscurity, and marks the position

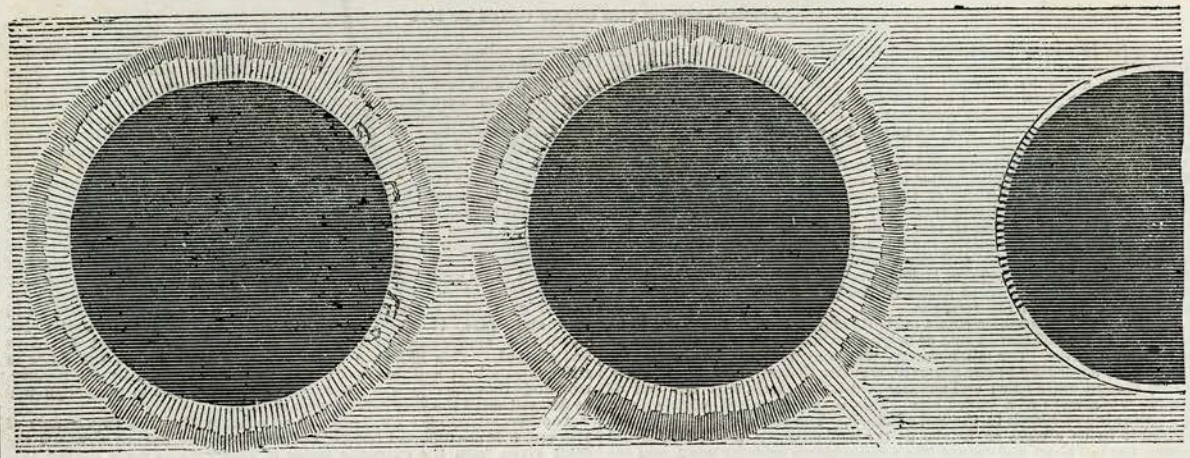


FIG. 1. FIG. 2. FIG. 3.

of both luminaries in the heavens. This crown generally takes a radiating form, some of the rays being much longer than others, as in Fig. 2 of the accompanying Diagram, which is copied from the description by M. Schmidt, of the total eclipse of July, 1851. This is generally supposed to be due to an atmosphere surrounding the Sun. In addition to this phenomenon, which has been seen at nearly every total eclipse, several rose-coloured prominences of irregular shape in immediate contact with the dark edges of the Moon were perceived with the greatest distinctness in the eclipses of 1842 and 1851. The first figure shows the form and position of those crimson protuberances, from which it will be seen that they are of fantastic shapes and at unequal distances apart. These are likewise generally supposed to have some connection with the atmosphere of the Sun, and to be the same as the bright and irregular streaks of light sometimes seen on its disc, and known by the name of faculæ. The most prominent of those rose-coloured spots were connected by a line of the same bright crimson tint, and the two lower ones presented an appearance similar to that of a flame blown aside by the wind (Fig. 4). These

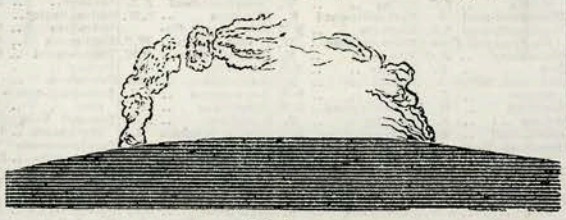


FIG. 4.

appearances have been observed in a greater or less degree in almost every other eclipse of the Sun, but have not been described with such minuteness. It would be desirable to note the form and position of all the dark spots and faculæ on the sun's disc for a few days previous to and following the eclipse. The faculæ are always most conspicuous at the margins of the Sun, and, like the spots, confined to the Sun's equatorial zone.

A remarkable appearance was noticed by Mr. Baily during the well-remembered annular eclipse of 1836, which had likewise been seen in former ones, although not apparently to such advantage. Just before the Moon was projected completely on the Sun, and the annulus formed, and when the dark margin of the Moon was almost in contact with the bright margin of the Sun, a number of dark lines or breaks were noticed in the thread of light on the western side of the Sun. This presented the appearance of a number of bright beads strung together (Fig. 3). As the Moon advanced on the Sun's disc those projections, which at first had the appearance of lunar mountains in high relief, seemed to increase in size, and were stretched out in the form of long dark lines, and, when the Moon was fairly projected on the Sun, they suddenly gave way, and the expected narrow thread of light of the annulus made its appearance. A similar row of lucid points was noticed just previous to the disappearance of the annulus when the eastern margins of the Sun and Moon were in contact, and, in fact, every appearance as at the beginning, but in an inverse order. It was noticed that these bright beads became more and more rounded the closer the margins of the Sun and Moon were in contact. They did not remain visible for more than six or eight seconds.

Although the rose-coloured prominences have been most conspicuously visible during total eclipses (and the same remark applies to the corona), yet similar appearances have been well seen during annular, and even partial, eclipses. In the annular eclipse of February 18, 1736, a portion of the corona was distinctly seen at that part of the Moon's circumference which had not yet entered upon the solar disc, and when a considerable part of the Sun was yet uncovered. In the annular eclipse of September 1820, just before the annulus was formed, a very small arch of light was perceived at that part of the Sun's disc yet unobscured, which appeared like a thin reddish thread of light, and might be compared, both as to colour and appearance, with the end of the flame of an Argand lamp. In the annular eclipse of May, 1836, shortly before the formation of the annulus, and when the cusps of the Sun were thirty or forty degrees from each other, an arch of faint red light was seen to extend between them, and this appearance lasted several seconds. Similar phenomena were seen in the United States during the eclipses of February, 1838 and 1847. In the partial eclipse visible at London on June 28, 1666, a small part of the disc of the Moon without the Sun was visible. In the excellent suggestions issued by the British Association for the observation of the total eclipse of July 28, 1851, it is stated, by an oversight, that the corona and red flames are only visible at the time of a total eclipse; but from the above observations it would appear that we may expect to see something of those phenomena during the present one, although not to such perfection as when the darkness is complete.

Some of the brighter stars and planets may be expected to be seen at the instant of total obscurity: Jupiter will be two hours and a half to the east of the meridian at this moment, and high up; Venus will be a little to the east of the Sun, and nearly in the same parallel; and Mercury will be to the west of the Sun and more than five degrees south of it. The principal stars in Lyra, Aquila, Cygnus, Pegasus, Andromeda, Aries, Perseus, Taurus, and Auriga, and the Pole Star, may also be looked for, and the places of such stars as are seen should be noted, so as to be able to identify them afterwards. In the "Suggestions" of the British Association for the observation of the last eclipse, it is recommended, among the coarser kinds of observation to be made with the naked eye, for the observer to notice whether bushes of light radiate from the corona; in what number and what direction; whether there are beams in the direction of the ecliptic, like pyramids, with their bases united at the Sun, in the manner of the Zodiacal light; whether there is a red band of light near the horizon or in any part of it; whether the outlines of hills can be seen; whether the smoke of chimneys can be seen; whether any plants (as the sensitive plant, the *convolvulus*, or the silk-tree *acacia*) close their leaves or petals; whether animals appear frightened; whether the light of the Sun appears to sweep over the country; whether there is any fluctuation of light on the ground or on walls; and, also, whether dew or fog is formed. To those observers furnished with a telescope it is recommended that they direct their attention as to whether the points of the cusps are rounded; whether in the neighbourhood of the cusp the limb either of the Sun or Moon appears distorted; whether the beads of light before mentioned appear steady or waving, disappearing and reappearing; whether they present any peculiar changes when viewed through differently-coloured glasses—the observer alternating the colours, which should be as dissimilar as possible, such as red and green; whether the beads are seen when the telescope is out of focus; whether they are seen when the eclipse is projected on a screen; the drawing out of the beads into threads when very near junction, and whether they waver and change, and the number of them; whether before and after the formation of the threads the Moon's dark disc is elongated towards the point of contact; as the beads are ascribed by some to lunar mountains, what mountains exist at that part of the limb; the exact interval of time before the first formation of beads and the first complete contact, and that between the last complete contact and the last disappearance of beads (or other irregularities in or about the cusps), should be determined; the remarkable fact of a recurrence of cusps, and the possible explanation of it, should be attentively considered. To those observers who may devote themselves to the phenomena of the rose-coloured prominences it is recommended, immediately before the total obscuration, to watch for the appearance of the prominences on all parts of the Sun's limb, but particularly at the part just about to be eclipsed by the Moon's limb; and to direct their second scrutiny to the diametrically opposite portion of the Moon's limb, watching for the summits of any prominences, and whether they enlarge as the total eclipse proceeds. In the third place, the observer should carefully examine the Moon's limb all round, and record the positions of any visible. The dimensions and forms of the prominences should be studied, whether they are hard and permanent, or with waving and ill-defined outlines; whether they are invariably broadest at the base, and have on the whole a tapering shape; whether they are seen to stand erect, or whether any or all of them are aslant, like teeth on the edge of a circular saw; whether they vary in outline during the scrutiny, or appear to grow up or to diminish. As the total phase goes off, let the eye be fixed on one or more of the prominences, and see whether they instantly or totally vanish, and for how many seconds they may be kept in view.

An excellent account of the Annular Eclipse of May 26, 1854, as observed in Canada, appears in the ILLUSTRATED LONDON NEWS of June of that year. Figures 5, 6, and 7 respectively represent the phases of the eclipse at London at 0h. 21m. P.M., 1h. 0½m. P.M., and 1h. 39m. P.M. of March 15th, 1858, as they will appear to the naked eye. The greatest obscuration takes place at 1h. P.M.

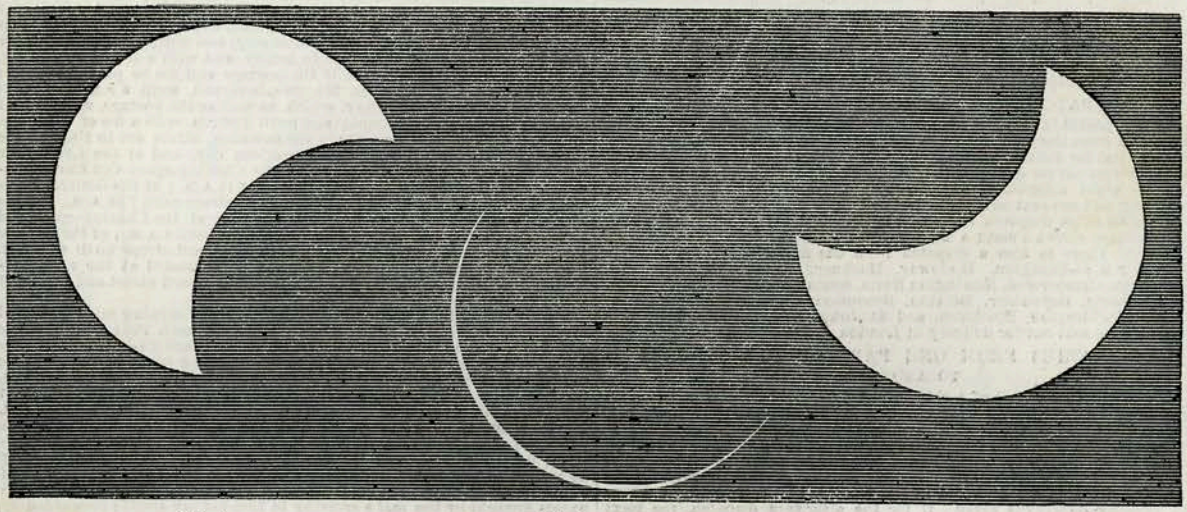


FIG. 5. FIG. 6. FIG. 7.