

ASTRONOMY

# The Eclipse of 1878

## "A Classic of Science"

### Fifty-Four Years Ago Langley Observed From Pike's Peak The Eclipse Which Will Recur in New England August 31

*ASTRONOMICAL AND METEOROLOGICAL OBSERVATIONS Made During the Year 1876, at the United States Naval Observatory. Appendix III. Reports on the Total Solar Eclipses of July 29, 1878 and January 11, 1880. Issued by the United States Naval Observatory. Washington, 1880.*

#### Report of Prof. S. P. Langley

AS ORIGINAL records of an observation are trustworthy in proportion as they have been presented in their first crude state, I endeavor to give the impressions as they rose in my mind, and will comment on them later. My first impression, then, of course was, "It is not so bright as those I have seen before;" my second, "but it is far more extended." I had before me a sheet of drawing-paper with a  $\frac{3}{4}$ -inch circle on it to represent the sun, and on this I traced an outline of what I then saw, before the eye had recovered its sensibility. The sun was surrounded by a narrow ring—hardly more than a line—of vivid light, presenting to the naked eye no trace of structure; which faded with great suddenness into a nebulous luminosity that at first appeared to extend to a distance of about two and one-half solar diameters all around. The outline of the faintest part was rudely circular, the brighter light extending farther in the direction of the ecliptic; and I particularly observed the absence of such marked striated structure in this outer part as I had seen at a distance of one diameter in the eclipse of 1869, when the air was decidedly less favorable than now. The nebulosity was not absolutely uniform, for it grew very slowly brighter till close to the sun, when it very suddenly brightened; neither was it absolutely structureless, but it was nearly so (to the naked eye) except in one direction. Making an angle of about  $45^\circ$  with the vertical, were two parallel lines stretching from extremities of a solar diameter (or from rather more) and extending three to three and one-

half diameters below and towards the right. The parallelism was to my eye exact, and they were connected by a fainter haze, whose tolerably definite outline was convex towards the sun. Upon the opposite side of the sun, to which I next looked, and in the same direction, the light stretched further into space to the extent of six diameters. . . . I now recurred to the rest of the corona and looked all around the sun without finding any well-marked ray other than those I have noted; but, observing that the light was (as the eye recovered its sensitiveness in the semi-darkness) now traceable much farther in every direction, I drew the second contour. I did not look again to the right of the sun, but turned my attention once more to the great extension on the left, which now presented extraordinary dimensions. Its axial line was almost exactly at an angle of  $45^\circ$  with the vertical, and passed nearly through the center of the sun or slightly below it.

The central part of the wing on the left near the sun was brighter than the edges, which were so diffuse, as to make the determination of its exact boundary difficult. It appeared to me, however, to be considerably more than a solar diameter in width, and it was now visible to fully twelve diameters in length. It was not so absolutely structureless as the zodiacal light, perhaps, and it appeared longer in proportion to its breadth than that; otherwise I should compare it to the zodiacal light with more confidence than to anything else.

I had now much reason to regret having exposed my eye, for it was evident that I was witnessing a real phenomenon heretofore undescribed, and yet that, while the eye was only growing into the proper condition for seeing its real extent, I must turn away. I think I must have gazed at the extension for over one-half the time at my command, looking down upon the white drawing paper to sketch its outline and gazing at it again. It did not momentarily

disappear, as a nebula does at night when the sketcher turns his eye from the feebly illumined paper. It remained, I repeat, persistently visible. The twelve diameters through which I traced it under these circumstances, I feel great confidence in saying were but a portion of its extent.

#### Telescopic View

There were but a few moments left when I turned to the telescope. It happened to be directed toward the northern part of the sun. I adjusted the eye-piece for distinct vision, which appeared excellent, but the view after this lasted, I think, not more than four or five seconds before totality was over. What I saw thus momentarily was not in the least what I expected. If there were any structure in the very inner corona, it had escaped me when I had searched for it in a previous eclipse (at Jeres, in 1870). It is true that the sky was hazy on that occasion, and that on this it was exquisitely clear. Now what I saw in this brief view was a surprisingly definite filamentary structure somewhat coarser and decidedly more sharply defined than I have ever seen filaments in the photosphere, not disposed radially, or only so in the rudest sense, sharpest and much the brightest close to the disc, fading rapidly away into invisibility at a distance of five minutes of arc or more (possibly in some cases of ten). The salient point to me was this very remarkable definiteness and precision of these forms. . . .

Immediately after totality my attention was directed by General Myer to the corona, which, as a narrow ring of light about the moon's preceding limb, was at first visible some one or two minutes of arc from the moon, and which, without any other precaution than masking the eye from direct sunlight, remained visible for over four minutes after totality. . . .

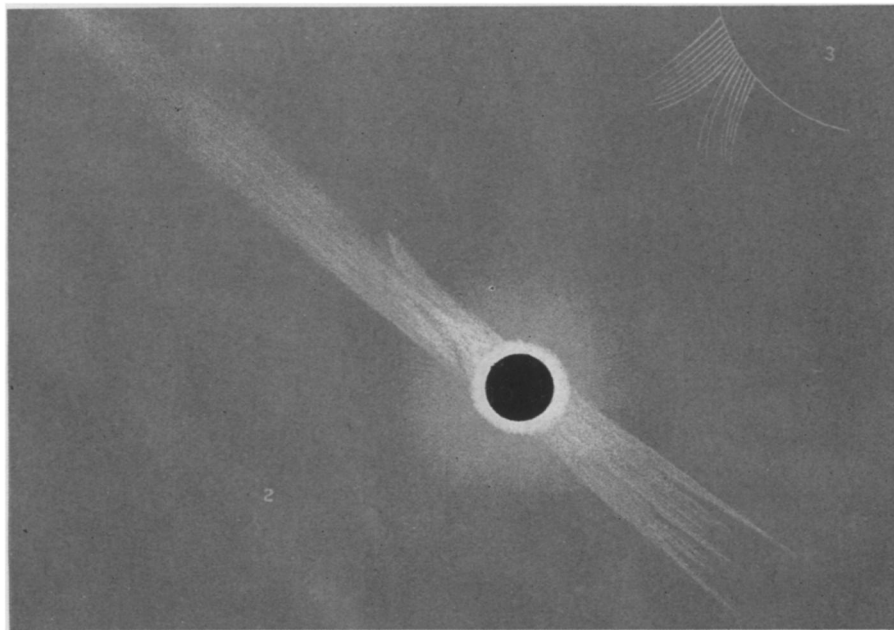
Mr. C. S. Shields, who was aiding me at another instrument near the brow of the mountain, found a few seconds of leisure to study the appearance of the light on extended clouds below us, as the shadow advanced. I regret not to have at hand his own words, as his report is not by me while I write; but

their substance was that just before the shadow fell on the clouds, the approach of totality was heralded by a bright yellow light all over them, passing into orange, pink, rose red, and dark red in a few seconds. This was followed by the blue-black shadow. Several others saw this brief but splendid spectacle. The colors were described as being comparable in vividness to those of a bright sunset. It is difficult to say how long it lasted; comparing all the evidence I received, I should say less than ten seconds. An interesting letter is appended from my friend, Mr. E. V. McCandless. He missed seeing the color, having turned at the instant to speak to some one behind him. It will also be noted that his eyes were fatigued by watching a brass instrument intently when he first looked up and saw the corona extending but a little way from the sun and that its extent grew as they recovered in part their sensitiveness. . . .

#### Report of Mr. E. V. McCandless

I had been assigned the duty of managing the "cat's-eye" of the heliostat. As the time of totality approached, I lay down on the rocks facing the sun, with hand and eyes on the instrument, ready for a signal to open or close. Looking off to the northwest, I could just see the tops of the Snowy Range, distant some 60 to 70 miles. Several bands of white clouds were in view far beyond the range and low on the horizon. Glancing from the instrument, I saw the farthest line of cloud had suddenly become of a deep blue-black hue. A moment later, and each band in succession became the same color, and then the Snowy Range suddenly dropped out of sight.

All my attention was now given to the "cat's eye" for twenty to thirty seconds after "total" had been announced. Finding my services were not required, I looked from the brass "cat's-eye" to the sun. I saw bright rays of light extending apparently to the southeast by east and to the northwest by west. Feeling that my eyes were dazzled by looking at the instrument, I closed and rubbed them for a few moments involuntarily. Again looking at the sun, I saw rays of light much more perfectly, and as I stood looking at them they increased in brightness and length. The rays seemed to be perfectly parallel, those on the western side being a continuation of those on the eastern, but not so long or bright. They appeared to be from two-thirds to three-fourths as wide as the sun;



DRAWING OF 1878 ECLIPSE MADE BY PROF. LANGLEY

From Pike's Peak, 14,400 feet high, the famous student of the sun (who also pioneered in aviation) saw a great extension of the corona which he faithfully recorded.

those on the western side appearing to my eyes to be about one and a half diameters of the sun in length, and those on the eastern side being about two and a half diameters in length.

The bounding or outer rays were much the brightest and most steady, the central rays seeming to tremble, or come and go. The impression created on my mind most vividly at the moment was as if next the sun was a great ocean, and the light was being reflected in brilliant parallel bands. There was a very bright, narrow glory of light all around the moon, but the absence of red surprised me.

Having finished the rough sketch for you, and about one minute or more of totality having passed, I walked over the extremely rough rocks to the northern edge of the Peak, having ample light; indeed, to test it, I looked at my watch and could see distinctly not only the hour and minute hands but the second hand also. The light was of a yellowish-green color. At the edge of the Peak I looked down on the mountain ranges of the "foot hills", some three thousand to five thousand feet below; Manitou Springs, with its hotels and cottages, some eight thousand feet below, and out on to the great plains stretching for 125 to 150 miles away, with Colorado Springs on the border near the foot hills, at not less than ten thousand feet less altitude than the Peak, and 13 miles away "as the crow flies".

All this was *clearly* seen, but bathed

in the most strange yellow light. What struck me at once was that there were *no shadows* to the mountains lying below me, but that all sides were equally light. They looked like "ghosts" of mountains, yet every outline was sharply defined. Turning to the northwest I could distinctly see the sharp outline against the sky of the Snowy Range, with its patches of snow. The bands of clouds were of a much less inky hue than they had at first appeared.

While looking at the clouds far beyond the Snowy Range, the first line sprang into light, and then each band in succession became white and bright. A moment later the mountain peaks suddenly appeared to be climbing up into space and were in brilliant light.

The shadow swept onward, across the South Park, and a moment later "Over" rang sharply over the Peak, and we were in sunlight. Away across the plains swept the shadow, a rounded ball of darkness with an orange-yellow border fading into the light pea-green of the landscape. As it reached the horizon, one hundred and fifty miles away, it lifted into space and was gone, having grown more and more dim as it swept away.

The above classic of science is particularly interesting because the August 31, 1932 eclipse is a repetition of the 1878 eclipse in the sequence of eclipses separated by "saros" periods. A "Langley Memorial Eclipse Expedition" from Science Service will occupy the summit of Mt. Washington, N. H., 6288 feet high, highest point within the path of totality of the August 31 eclipse, which extensively equipped expeditions have avoided on account of unfavorable weather probabilities.

Science News Letter, August 27, 1932