

ART. XXIII — *Auroral Belt of October 24th–25th, 1870.*

THERE was seen at New Haven on Monday and Tuesday evenings, October 24th and 25th last, and at other distant places, in the United States, a belt of deep rose or crimson color from east to west across the southern sky, which possessed very uncommon, if not altogether novel characteristics,—among which the following may be instanced. *First*, its breadth was extreme. The writer estimated it at fifteen degrees, which is fully three times the ordinary breadth. *Second*, both its color and its consistence were wholly unlike anything seen at this place before, so far as is known, pertaining to this particular class of auroral phenomena. The “Aurora’s Bow,” as this class is called, has always hitherto displayed a yellowish white, like a mildly illuminated strip of cloud, and with a uniform cloud-consistence, although sometimes—very rarely—broken into parallel cross fleeces moving west. In this instance the bow was an assemblage of a few great masses irregularly bounded and illuminated, and in color resembling the ordinary red streamers deepened and darkened in hue. This color prevailed uniformly without intermixture with any other; but the component masses would progressively fade, without disappearing, and again recover brightness. *Third*, this class of arches has ever been noticed to form with suddenness and rapidity, and in motion southward to a stationary position, in which, after from twenty minutes to an hour, the arch would disappear. But in the present instance the bow was permanent, having, as here seen, the same situation, essentially, among the stars throughout Monday evening and night, and the like on Tuesday evening so far as the prevalent mists of that evening would allow observation. In parts of New Jersey, and south of Philadelphia, it appears to have kept nearly one place for forty-eight hours. *Fourth*, these arches hitherto have occupied the position of small circles in the northern hemisphere; but this occupied, here, a great circle, at least from ten o’clock on Monday night to one o’clock on Tuesday morning,—and approximately, the same for two hours earlier in the evening. This position lay centrally in the circle

through or near the stars Alpha Aquilæ, Zeta Aquarii. Eta Ceti and Gamma Eridani; to which last it extended at midnight of Monday and after. At a time during the earlier hours, after nine o'clock and probably at about half past nine, the accurate observer Mr. Willard J. Gibbs, viewing this from an elevated station, concluded that the arch cut the western horizon at or near W. 8° N., and the eastern not farther from the south than S. 28° E. This would consist only with its being, at that time, a small circle in the southern magnetic hemisphere. Its path otherwise and its culmination were not noted by Mr. Gibbs. It deserves mention also that an observer of trustworthy accuracy describes the position in the due southeast, at two minutes before six o'clock, as being at that time nine degrees more south than the then position of the great circle above described would give it. Therefore in comparing mine with any observations made at other places earlier than ten o'clock New Haven time it would be prudent to allow for the culminating point at this place a few degrees of southing compared with the culmination of the circle described,—but not more than three degrees at nine o'clock and six degrees at eight o'clock.

At about this last mentioned time the belt was carefully located by observation made at Burlington, N. J. ($115\frac{1}{2}$ miles S. $50^{\circ} 22'$ W. from New Haven), by B. V. Marsh, Esq., who with others observed the phenomena during the evening of Monday, and until half an hour past midnight (Oct. 24th.) From Mr. Marsh's letters to Professor Newton descriptive of the belt I make extracts as follows:—"During all this time—say six hours—a crimson arch (more or less perfect) extended from near the N.E. horizon to near the N.W. horizon varying but little in position. At eight o'clock I noted its position with some care—by the aid of a globe. Its northern edge (which however was *not* sharply defined or very regular) passed about 25° S. of the zenith, and if continued would, I thought, have cut the horizon about N. 45° W. The arch or band was from 10° to 20° wide, perhaps 15° on an average. The color was a very deep crimson (at times) and was especially conspicuous in the N.W. and N.E., although very bright near the meridian also. There was in the north an imperfect and rather faint arch of streamers of a yellowish white color with a dark segment below. Up to half past ten o'clock there was no waving or flashing, but later there was considerable activity that way. Between ten and half past ten the arch seemed to cross the zenith a few degrees farther south than at eight o'clock." In a subsequent letter Mr. Marsh states "the arch [north edge] would have cut the horizon but little if any N. of East. The crimson light reappeared in nearly the same position the next evening."

Referring these statements concerning the north edge of the belt to its central line; it appears that the latter cut the horizon at about W. 30° N. and E. 15° S. and culminated about S. 22° W., having a zenith distance at eight o'clock of $32\frac{1}{2}^{\circ}$. The culmination at New Haven (lat. $41^{\circ} 18'$) at the same absolute time, was near S. 20° W. and at $44\frac{1}{2}^{\circ}$ in altitude, allowing five degrees and a half southing from the great circle, for the reason just stated, giving a

corrected difference of parallaxes— 21° oblique to the meridians—of $10\frac{1}{2}^\circ +$, and concomitant to a difference of bases or chords of $100\frac{1}{4}$ miles:—which bring out a height of 339 miles vertical in lat. $37^\circ 18' 4''$, or $1^\circ 35'$ south of Washington. This would imply that the belt, as seen at Washington, culminated more than 19° south of the zenith. According to the printed account of what was seen at that place—a copy of which in manuscript the writer has received from a trusted correspondent, and has given below—that observed distance was, in fact, but 9° ;—however, the tendency to underestimate angular distances near the zenith is so universal that it would not be strange or unexpected to find nineteen degrees of zenith distance described as only nine degrees. This view is confirmed, in the present instance, by the analogous contracted estimate of breadth; which is called but 8° , when, from its nearer proximity to Washington than to Burlington, or to New Haven, it might be expected to subtend an angle of at least 16° or 20° . The account from Washington referred to is the following:—

“October 24—There is a very unusual auroral display to night. The northern sky to the elevation of 30° is brilliant with white light; but a distinct feature consists of a band of blood-red color starting from a point only 8° or 10° N. of W. passing 5° S. of the zenith and touching the horizon again a little S. of East. The breadth of the band is about 8° , and it is very strongly defined throughout.”—The probability really is, in accordance with what has been suggested, that, instead of 5° , the north edge passed south of the zenith by as much as 10° ; and its middle line nearly as much in addition. The foregoing conclusions are thus substantially confirmed by the observation at Washington; and they make the belt to have been about vertical to Richmond in Virginia,—while it must, equally, have been brilliant not only in central Virginia but through the Carolinas. Investigation will doubtless bring to light the means of a yet more complete and accurate determination of the height and position.

The position of the belt on Tuesday evening, the 25th, is thus described in a letter from W. C. Taylor, Esq., of Philadelphia as seen by him at $9^h 35^m$ P. M., at a station seven miles E.S.E. from Philadelphia. “The breadth of the crimson was tolerably uniform, having an average of about 12° . The general direction of the most distinct portion would be indicated by a line through Altair, the trapezium in the Dolphin, and 2° north of the southeastern star in the square of Pegasus.” By this evidence it appears that the belt held a more northern situation at that time than upon the preceding evening. Mr. Marsh informs me that the same was seen to continue, during the evening without “apparent change of position” and until the next morning, by an acquaintance of his—a citizen of Philadelphia—who was traveling from that city to Richmond. He also states that the brilliant crimson light in the northwest had been seen on Monday morning. The same, it appears by the newspapers, was seen also at Cincinnati on that morning in the northeast, “resembling the lights of an immense

fire," and also at St. Louis "illuminating the whole heavens as by a great conflagration."

It only remains to state respecting the aurora of Monday evening, as observed by the writer at New Haven, that by eleven o'clock the faint bank of yellowish white light which, together with a few streamers of a corresponding color, rested low in the north through the hours from six till ten and after, had become suddenly developed into a glowing sheet that covered the entire western, northern, and eastern sky,—everywhere striated and pillared in the western parts with red streamers, and with brilliant white, and pale yellow in the northeast and east. All these had as their base a low yellowish cloud arching over a well defined dark space, whose upper limit, in contact with the bright arch above it, extended about 55° from west of north to east of north, and 7° or 8° high near the north. There were radiations which reached up to a corona having its position in the ordinary relation to the dipping needle's direction, and far north of the great east-and-west crimson belt. The illuminated and extended sheet was pervaded by incessant auroral waves that passed upward with an uncommonly well established and traceable propagation from the cloud arch to the corona, and with an angular velocity estimated to be 112° in a second. This great and rare magnificence maintained itself till one hour after midnight, and then, for the time at least, it passed away.

A. C. T.