ART. XII.—*The Great Auroral Exhibition of Aug. 28th to Sept. 4th*, 1859.—7TH ARTICLE; by ELIAS LOOMIS, Professor of Natural Philosophy and Astronomy in Yale College.

SINCE the publication of my last auroral article I have obtained some additional information, chiefly collected during a recent visit to Europe.

1. *Observations at Highland, Illinois*, (lat. 38° 43′, long. 89° 48′ W.), *by* A. F. BANDELIER, Jr.

At 9 P. M. Aug. 28, 1859, I was struck by the appearance of a broad purple ray extending lengthwise across the seven stars of Ursa Major to 80° of height. This ray remained for about half an hour, rapidly changing. Then appeared three rays in the east inclining to the south, which ascended from a bright yellow circle resting upon a segment of a brown misty appearance. Both arch and segment were gradually rising, the former illuminated as by the faint lightning of a distant tempest. The segment greatly agitated near its upper border, tossing and rolling its cloudy particles over each other in heavy undulations. No more rays appeared, but the yellow arch and the segment rose slowly. Through the latter I saw plainly $\alpha$ Aurigae rise without much diminution of brightness.

At 1 o'clock a quantity of rays shot upwards from the lucid arch, purple at the base and middle, brilliant yellow at the top. A little S.E. from the zenith they united, forming a small semicircle of the most dazzling beauty, from which rays now shot downwards. The corona lasted only a few minutes, then broke up and vanished. Some rays continued after it, but the great movement of the arch and segment ceased gradually.

At 4 A. M. both still stood on the northern horizon. The greatest height of the arch during the whole apparition was 60°, that of the segment was 20° to 25°.

Sept. 2d at 9 P. M. I observed a dark segment in the north looking very much like a fog, of an irregular circular form, the upper borders broken up, and 5° or 6° above the horizon at its greatest elevation. Behind it a faint light broke out, not unlike a distant prairie fire. The whole ranged from 10° west to 40° east. At $9^h\ 20^m$ four rays darted out directly north. They were of a pale milky color. They seemed to descend into the segment below, and then suddenly prolonged themselves into the true ray or flame. The same lightning-like illumination of the arch was visible as in the aurora of Aug. 28th.

At $9^h\ 30^m$ a strong ray appeared N. 20° E.

At $9^h\ 35^m$ light diminishing east.

At $9^h\ 45^m$ strong decrease. Segment almost without motion; its borders were now completely regular; continued to decrease and fall below the horizon.

At $10^h\ 30^m$ only feebly visible.

At $11^h\ 2^m$ segment only a small stripe of 2° in breadth, a faint lighted border.

At $3^h\ 30^m$ A. M. all had entirely vanished. Clouds were gathering from the south.

2. *Observations at Greenwich, England,* (lat. 51° 28′), *communicated by* Prof. G. B. Airy, Astronomer Royal of Great Britain.

| Greenwich mean time. | Western declination. | Greenwich mean time. | Horizontal force. | Greenwich mean time. | Vertical force. |
|---|---|---|---|---|---|
| *h m* | ° ′ ″ | *h m* | | *h m* | |
| August 28th. | | August 28th. | | August 28th. | |
| 0 0 | 21 31 30 | 0 0 | ·0897 | 0 0 | ·02143 |
| 5 23 | 21 12 30 | 2 15 | ·0953 | 3 15 | ·02170 |
| 8 15 | 21 17 15 | 3 30 | ·0890 | 6 40 | ·01969 |
| 11 15 | 21 52 10 | 5 0 | ·0926 | 9 4 | ·01880 |
| 11 20 | 20 57 30 | 5 25 | ·0935 | 10 39 | ·02019 |
| 11 38 | 21 52 10 | 7 45 | ·0904 | 11 46 | ·01510 |
| 12 46 | 20 47 10 | 8 19 | ·0897 | 12 37 | ·00260 |
| 14 4 | 21 53 5 | 9 15 | ·0916 | 13 2 | ·01561 |
| 14 45 | 21 16 50 | 9 51 | ·0929 | 13 21 | ·00263 |
| 16 5 | 22 1 50 | 21 0 | ·0832 | 14 9 | ·01836 |
| 17 11 | 21 3 0 | | | 14 27 | ·01340 |
| 18 9 | 21 23 30 | | | 16 49 | ·02263 |
| 18 55 | 21 5 30 | | | 18 10 | ·00840 |
| 19 6 | 21 55 40 | | | 22 6 | ·02251 |
| 21 15 | 21 4 10 | | | 22 43 | ·02120 |
| August 29th. | | August 29th. | | August 29th. | |
| 0 0 | 21 34 10 | 0 0 | ·0845 | 0 0 | ·02143 |
| 2 39 | 21 27 10 | 3 13 | ·0933 | 2 30 | ·01989 |
| 5 28 | 21 7 10 | 3 50 | ·0958 | 5 10 | ·01556 |
| 5 50 | 21 24 20 | 4 9 | ·0809 | 5 26 | ·01580 |
| 7 20 | 21 16 30 | 5 30 | ·0895 | 7 22 | ·01352 |
| 14 26 | 28 0 | 18 27 | ·0865 | 12 28 | ·01464 |
| 19 46 | 12 0 | 19 39 | ·0832 | 14 58 | ·01654 |
| 23 45 | 29 30 | 21 56 | ·0844 | 19 20 | ·02229 |
| August 30th. | | August 30th. | | August 30th. | |
| 0 0 | 21 28 20 | 0 0 | ·0861 | 0 0 | ·01882 |
| 5 20 | 20 25 | 2 39 | ·0886 | 9 18 | ·01349 |
| 12 52 | 27 50 | 7 45 | ·0880 | 18 47 | ·01963 |
| 19 3 | 15 0 | 14 14 | ·0893 | 23 15 | ·01730 |
| 21 37 | 20 30 | 21 45 | ·0854 | 23 59 | ·01481 |

*Table continued.*

| Greenwich mean time. | Western declination. | Greenwich mean time. | Horizontal force. | Greenwich mean time. | Vertical force. |
|---|---|---|---|---|---|
| *h m* | ° ′ ″ | *h m* | | *h m* | |
| August 31st. | | August 31st. | | August 31st. | |
| 0 0 | 21 46 10 | 0 0 | ·0867 | 0 0 | ·01481 |
| 7 6 | 18 40 | 7 18 | ·0900 | 5 15 | ·00950 |
| 9 22 | 9 30 | 9 20 | ·0909 | 16 40 | ·01563 |
| 14 10 | 23 40 | 12 45 | ·0883 | 17 30 | ·00301 |
| 16 17 | 22 5 20 | 15 53 | ·0930 | 17 45 | ·04158 |
| 19 45 | 20 57 45 | 18 47 | ·0839 | 17 56 | ·02297 |
| 20 12 | 20 31 10 | 19 30 | ·1027 | 18 20 | ·04261 |
| 20 14 | 21 7 10 | 20 10 | ·0763 | 18 30 | ·02722 |
| 20 16 | 20 55 10 | 20 15 | ·0940 | 18 41 | ·04139 |
| 20 18 | 21 22 20 | 20 41 | ·0841 | 19 6 | ·02228 |
| 20 24 | 20 56 25 | 20 50 | ·0938 | 19 15 | ·02817 |
| 20 27 | 21 24 10 | 21 19 | ·0787 | 20 15 | ·02031 |
| 21 40 | 21 1 30 | 21 44 | ·0947 | 20 33 | ·02166 |
| 22 10 | 21 26 10 | 22 15 | ·0777 | 21 37 | ·02097 |
| 22 42 | 21 10 0 | 23 10 | ·0888 | 23 20 | ·01730 |
| September 1st. | | September 1st. | | September 1st. | |
| 0 0 | 21 33 35 | 0 0 | ·0885 | 0 0 | ·01719 |
| 1 56 | 42 35 | 1 57 | ·0906 | 8 33 | ·01051 |
| 8 20 | 15 0 | 4 28 | ·0885 | 21 0 | ·01658 |
| 14 10 | 25 35 | 9 21 | ·0900 | 23 30 | ·01563 |
| 20 0 | 12 30 | 13 0 | ·0905 | 23 43 | ·01438 |
| 23 42 | 35 40 | 20 55 | ·0873 | 23 56 | ·02043 |
| 23 54 | 8 45 | 22 40 | ·0869 | | |
| September 2d. | | September 2d. | | September 2d. | |
| 0 0 | 21 18 0 | 0 0 | ·0940 | 0 0 | ·01978 |
| 0 16 | 4 10 | 1 33 | ·1069 | 1 22 | ·02556 |
| 1 4 | 53 10 | 1 39 | ·0817 | 1 36 | ·01963 |
| 1 13 | 11 5 | 1 59 | ·1065 | 1 53 | ·02437 |
| 1 18 | 52 15 | 2 27 | ·0778 | 2 17 | ·02197 |
| 1 40 | 21 10 | 2 52 | ·1120 | 2 48 | ·02769 |
| 1 54 | 58 50 | 3 23 | ·1003 | 3 13 | ·02203 |
| 2 13 | 11 15 | 3 37 | ·1078 | 3 30 | ·02400 |
| 2 30 | 51 40 | 5 43 | ·0930 | 5 47 | ·01988 |
| 2 43 | 13 10 | 6 30 | ·0964 | 6 3 | ·02142 |
| 3 40 | 51 25 | 8 40 | ·0850 | 8 37 | ·01602 |
| 3 57 | 23 10 | 9 25 | ·0937 | 9 5 | ·01670 |
| 5 50 | 40 0 | 11 29 | ·0802 | 10 47 | ·01200 |
| 6 15 | 0 30 | 12 43 | ·0945 | 11 17 | ·01329 |
| 7 0 | 24 10 | 12 54 | ·0816 | 11 32 | ·01063 |
| 8 51 | 20 53 0 | 14 48 | ·0884 | 12 37 | ·01293 |
| 9 40 | 21 32 0 | 16 13 | ·0816 | 12 56 | ·01142 |
| 11 4 | 21 6 25 | 18 25 | ·0848 | 14 40 | ·01290 |
| 11 43 | 21 42 20 | 21 35 | ·0812 | 14 57 | ·01221 |
| 14 15 | 21 5 30 | 23 12 | ·0833 | 15 50 | ·01320 |
| 15 52 | 27 20 | | | 16 6 | ·01281 |
| 20 15 | 15 30 | | | 18 48 | ·01556 |
| September 3d. | | September 3d. | | September 3d. | |
| 0 12 | 21 27 20 | 0 0 | ·0889 | 0 0 | ·01739 |
| 3 3 | 58 45 | 0 31 | ·0940 | 3 30 | ·01620 |
| 5 53 | 21 10 | 3 15 | ·0837 | 4 40 | ·01946 |
| 6 12 | 20 50 5 | 5 9 | ·1075 | 5 32 | ·01683 |
| 6 53 | 21 28 15 | 6 27 | ·0887 | 6 4 | ·01936 |
| 7 30 | 0 30 | 6 31 | ·0930 | 6 58 | ·01300 |

*Table continued.*

| Greenwich mean time. | Western declination. | Greenwich mean time. | Horizontal force. | Greenwich mean time. | Vertical force. |
|---|---|---|---|---|---|
| *h m* | ° ′ ″ | *h m* | | *h m* | |
| September 3d. | | September 3d. | | September 3d. | |
| 7 58 | 21 28 30 | 8 5 | ·0835 | 7 26 | ·01405 |
| 8 15 | 11 30 | 10 44 | ·0891 | 8 4 | ·01347 |
| 11 50 | 36 0 | 12 39 | ·0811 | 8 15 | ·01425 |
| 13 8 | 15 10 | 13 45 | ·0850 | 12 36 | ·00900 |
| 16 7 | 25 0 | 15 15 | ·0822 | 15 7 | ·01510 |
| 21 6 | 13 0 | 19 21 | ·0861 | 19 38 | ·01923 |
| September 4th. | | September 4th. | | September 4th. | |
| 0 0 | 21 33 0 | 0 0 | ·0830 | 0 0 | ·01809 |
| 1 20 | 41 45 | 2 15 | ·0936 | 2 4 | ·01763 |
| 2 37 | 22 30 | 3 22 | ·0845 | 2 36 | ·01846 |
| 3 30 | 30 20 | 3 52 | ·0912 | 3 37 | ·01682 |
| 10 54 | 12 10 | 5 19 | ·0837 | 3 56 | ·01701 |
| 12 4 | 30 30 | 12 55 | ·0877 | 14 4 | ·01102 |
| 19 23 | 3 30 | 13 54 | ·0827 | 21 53 | ·01732 |
| 23 15 | 37 10 | 19 32 | ·0883 | 23 59 | ·01739 |
| | | 23 12 | ·0790 | | |

3. *Deflections of the needles of the Vertical Galvanometers of Cooke and Wheatstone's Telegraph instruments, observed at Ramsgate Station in the County of Kent, England, upon three distinct lines of telegraph: namely, Ashford and Margate, distant in a direct line* 27½ *miles; Ashford and Ramsgate, distant* 27½ *miles; Ramsgate and Margate,* 8 *miles;* furnished by Mr. CHARLES V. WALKER.

*Note.*—The direction in which the current moves is indicated by the letters N and S; N means that the current is from the more northerly to the more southerly station of the two; S means the reverse. The direction of Ashford from Ramsgate is S. 60° W., and that of Margate from Ramsgate N. 22° W.

In the "value column," "strong" means 30° or 40°; "hard over," 45°; horizontal from 70° to 80°. Ordinary strong telegraph signals produce about 60°.

| Date. | Time. | | Telegraph Line. | Direction. | Value. |
|---|---|---|---|---|---|
| 1859. | | | | | |
| Aug. 29th | 7·10 A. M. | 7·25 A. M. | Ashford and Margate, | S | Strong. |
| " | 7·36 " | 7·45 " | " " " | S | Hard over. |
| " | 7·46 " | 7·49 " | " " Ramsgate, | N | Strong. |
| " | 7·50 " | 8· 0 " | " " " | S | Hard over. |
| " | 9·45 " | 10· 0 " | " " " | N | " " |
| " | 10·20 " | 10·27 " | " " " | N | Strong. |
| " | 10·27 " | 10·28 " | " " " | S | Hard over. |
| " | 10·28 " | 10·36 " | " " " | N | Strong. |
| " | 10·37 " | 10·40 " | " " " | S | Hard over. |
| " | 10·40 " | 10·45 " | " " Margate, | N | " " |
| " | 10·45 " | 10·49 " | Margate and Ashford, | S | " " |
| " | 10·50 " | 10·53 " | " " " | N | " " |
| " | 10·53 " | 11· 0 " | " " " | S | Horizontal. |
| " | 11· 2 " | 11·25 " | " " " | N | " |
| " | 11·25 " | 11·40 " | " " " | N | Hard over. |
| " | 11·45 " | 12·20 P. M. | " " " | N | " " |
| " | 12·30 P. M. | 12·45 " | " " " | N | Strong. |
| " | 12·48 " | 1· 3 " | " " " | N | " |
| " | 1· 5 " | 1·40 " | " " " | S | " |

*Table continued.*

| Date. | Time. | | Telegraph Line. | Direction. | Value. |
|---|---|---|---|---|---|
| 1859. | | | | | |
| Aug. 29th | 2·40 P. M. | 2·53 P. M. | Margate and Ashford, | N | Very Strong. |
| " | 3·40 " | 3·50 " | " " " | N | " " |
| " | 3·52 " | 4· 5 " | " " " | S | Horizontal. |
| " | 3·52 " | 4· 5 " | Ashford and Ramsgate, | S | Very strong. |
| " | 4·15 " | 4·50 " | " " Margate, | N | " " |
| " | 5· 0 " | 5·20 " | " " " | N | " " |
| " | " " | " " | " " Ramsgate, | N | " " |
| " | 5·25 " | 5·48 " | " " Margate, | N | " " |
| " | 6·10 " | 6·23 " | " " " | S | " " |
| " | 6·50 " | 7·20 " | " " " | S | " " |
| " | 7·53 " | 8·10 " | " " " | S | Slight. |
| Sept. 1st | 11·20 A. M. | 11·26 A. M. | " " " | S | Strong. |
| " | 11·28 " | 11·35 " | " " " | N | Slight. |
| Sept. 2d | 7·10 " | 7·42 " | " " " | N | Horizontal. |
| " | 7·10 " | 7·50 " | Ramsgate and Margate, | N | " |
| " | 7·10 " | 7·42 " | Ashford and Ramsgate, | N | " |
| " | 7·43 " | 7·48 " | " " Margate, | S | Strong. |
| " | " " | " " | " " Ramsgate, | S | " |
| " | 7·49 " | 7·51 " | " " Margate, | N | Hard over. |
| " | " " | " " | " " Ramsgate, | N | " " |
| " | 7·51 " | 7·56 " | " " Margate, | S | " " |
| " | " " | " " | " " Ramsgate, | S | " " |
| " | 7·56 " | 8· 0 " | " " Margate, | N | " " |
| " | " " | " " | " " Ramsgate, | N | " " |
| " | " " | " " | Ramsgate and Margate, | N | " " |
| " | 8· 0 " | 8· 7 " | Ashford and " | S | Strong. |
| " | " " | " " | " " Ramsgate, | S | " |
| " | " " | " " | Ramsgate and Margate, | S | " |
| " | 8· 8 " | 8·12 " | Ashford and " | S | " |
| " | " " | " " | " " Ramsgate, | S | " |
| " | " " | 8·17 " | Ramsgate and Margate, | S | " |
| " | 8·12 " | " " | Ashford and Ramsgate, | S | Hard over. |
| " | " " | " " | " " Margate, | S | " " |
| " | 8·20 " | 8·30 " | " " Ramsgate, | N | " " |
| " | " " | " " | " " Margate, | N | " " |
| " | 8·31 " | 8·46 " | " " " | S | " " |
| " | " " | 8·40 " | " " Ramsgate, | S | " " |
| " | 8·41 " | 8·46 " | " " " | N | " " |
| " | " " | " " | " " Margate, | N | " " |
| " | 8·47 " | 8·54 " | " " " | S | " " |
| " | " " | " " | " " Ramsgate, | S | " " |
| " | 8·54 " | 9· 0 " | " " " | N | Strong. |
| " | " " | " " | " " Margate, | N | " |
| " | 9·22 " | 9·25 " | " " " | N | " |
| " | 9·26 " | 9·28 " | " " " | S | " |
| " | 9·29 " | 9·40 " | " " " | N | " |
| " | 9·40 " | 9·52 " | " " " | S | " |
| " | 9·55 " | 10·32 " | " " " | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | 10·35 " | 10·38 " | " " Margate, | S | " |
| " | 10·38 " | 10·40 " | " " " | N | " |
| " | 10·41 " | 10·46 " | " " " | S | " |
| " | 10·55 " | 11· 0 " | " " " | S | " |
| " | 11· 2 " | 11·15 " | " " " | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | 11·16 " | 11·27 " | " " Margate, | S | " |
| " | 11·20 " | 11·32 " | " " Ramsgate, | S | " |
| " | 11·38 " | 11·40 " | " " Margate, | N | " |
| " | 11·40 " | 11·45 " | " " " | S | " |
| " | 11·45 " | 11·49 " | " " " | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | " " | 11·50 " | Ramsgate and Margate, | N | " |
| " | 11·50 " | 11·51 " | Ashford and " | S | " |
| " | " " | " " | " " Ramsgate, | S | " |
| " | " " | " " | Ramsgate and Margate, | S | " |
| " | 11·52 " | 11·54 " | Ashford and Ramsgate, | N | " |

*Table continued.*

| Date. | Time. | | Telegraph line. | Direction. | Value. |
|---|---|---|---|---|---|
| 1859. | | | | | |
| Sept. 2d | 11·52 A. M. | 11·54 A. M. | Ramsgate and Margate, | N | Strong. |
| " | " " | " " | Ashford and " | N | " |
| " | 11·59 " | 12· 3 P. M. | " " Ramsgate, | N | " |
| " | " " | " " | " " Margate, | N | " |
| " | " " | " " | Ramsgate and " | N | " |
| " | 12· 4 P. M. | 12·14 " | Ashford and Ramsgate, | S | Horizontal. |
| " | " " | " " | " " Margate, | S | Strong. |
| " | 12·15 " | 12·30 " | " " " | N | Horizontal. |
| " | " " | " " | " " Ramsgate, | N | Strong. |
| " | 12·30 " | 12·35 " | " " Margate, | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | " " | " " | Ramsgate and Margate, | N | " |
| " | 12·36 " | 12·57 " | Ashford and " | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | 12·57 " | 1·18 " | " " Margate, | S | " |
| " | " " | " " | " " Ramsgate, | S | " |
| " | " " | " " | Ramsgate and Margate, | S | " |
| " | 1·20 " | 1·44 " | Ashford and " | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | " " | " " | Ramsgate and Margate, | N | " |
| " | 1·44 " | 1·47 " | Ashford and Ramsgate, | S | " |
| " | " " | " " | " " Margate, | S | " |
| " | 1·47 " | 1·54 " | " " " | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | 2· 0 " | 2·15 " | " " Margate, | N | " |
| " | " " | " " | " " Ramsgate, | N | " |
| " | 2·15 " | 2·18 " | " " Margate, | S | " |
| " | " " | " " | " " Ramsgate, | S | " |
| " | 2·21 " | 2·31 " | " " Margate, | S | Horizontal. |
| " | " " | 2·37 " | " " Ramsgate, | S | " |
| " | 2·38 " | 2·52 " | Ramsgate and Margate, | N | Strong. |
| " | " " | " " | Ashford and Ramsgate, | N | " |
| " | " " | " " | " " Margate, | N | " |
| " | 2·52 " | 2·55 " | Ramsgate and " | S | " |
| " | " " | " " | Ashford and Ramsgate, | S | " |
| " | " " | " " | " " Margate, | S | " |
| " | 2·55 " | 3· 2 " | Ramsgate and " | N | " |
| " | " " | " " | Ashford and Ramsgate, | N | " |
| " | " " | " " | " " Margate, | N | " |

4. *Auroral observations made at Sea; furnished by* Rear-Admiral Robert Fitz Roy, of the British Navy.

A. Lat. 50° 47′ N., long. 10° 12′ W.

Aug 28th. About $11^h\ 30^m$ P. M. the sky being cloudy, it brightened up like daybreak, remained so for twenty minutes, then turned a dark red, and soon after darkened in again as before.

B. Lat. 29° 48′ N., long. 45° 20′ W.

Aug. 28th. The aurora seen from 9 P. M. till 4 A. M. the next morning, of a rose color. Streamers about 30° high.

C. Lat. 26° 48′ N., long. 45° 40′ W.

Aug. 28th. Sky in the S.S.E. of a lurid fiery color; a vivid bright streak from the middle.

D. Lat. 25° 45′ N., long. 27° 4′ W.

Aug. 28th. From $11^h\ 15^m$ P. M. till midnight the N.W. portion of the sky of a deep red color, resembling an angry sunrise.

E. Lat. 33° 55′ N., long. 44° 13′ W.

Sept. 2d. The aurora faintly visible in the north about 4 A. M.

F. Lat. 33° 33′ N., long. 33° 2′ W.

Sept. 2d. At 3 A. M. a low bank of straw colored aurora on the northern horizon; it became a beautiful rose color, covering about four-tenths of the sky and gradually disappeared as the day broke.

G. Lat. 24° 10′ N., long. 35° 50′ W.

Sept. 2d. Aurora seen in the morning from N.W. to E.N.E. of a bright red color, interspersed with streaks of white, converging to a center nearly over the ship.

5. *State of the weather at the Russian magnetic observatories, during the Auroral display of Aug.* 28*th to Sept.* 2*d*, 1859; *furnished by* A. T. KUPFFER, Director of the Central Physical Observatory.

| Hour. | St. Petersburg. | Catherinburg. | Barnaoul. | Nertchinsk. |
|---|---|---|---|---|
| | August 28th, 1859. | | | |
| 0 | overcast | cloudy | scat. clouds | overcast |
| 1 | overcast | overcast | scat. clouds | overcast |
| 2 | cloudy | overcast | scat. clouds | overcast |
| 3 | cloudy | overcast | scat. clouds | overcast |
| 4 | cloudy | cloudy | scat. clouds | overcast |
| 5 | cloudy | cloudy | clouds in hor'n | overcast |
| 6 | cloudy | cloudy | clouds in hor'n | overcast |
| 7 | cloudy | cloudy | clouds in hor'n | clouds in hor'n |
| 8 | cloudy | cloudy | clear | clouds in hor'n |
| 9 | cloudy | cloudy | clear | cloudy |
| 10 | light clouds | cloudy | clear | cloudy |
| 11 | light clouds | clouds in hor'n | clear | cloudy |
| 12 | light clouds | clear | clear | cloudy |
| 13 | cloudy | clear | clear | overcast |
| 14 | cloudy | clear | clear | overcast |
| 15 | cloudy | clear | clear | overcast |
| 16 | cloudy | clear | clouds in hor'n | overcast |
| 17 | cloudy | clouds in hor'n | clouds in hor'n | overcast |
| 18 | cloudy | clouds in hor'n | clouds in hor'n | overcast |
| 19 | cloudy | clouds in hor'n | clouds in hor'n | overcast |
| 20 | cloudy | clouds in hor'n | clouds in hor'n | clouds in hor'n |
| 21 | cloudy | cloudy | scat. clouds | clouds in hor'n |
| 22 | cloudy | cloudy | scat. clouds | cloudy |
| 23 | cloudy | cloudy | scat. clouds | cloudy |
| | September 2d, 1859. | | | |
| 0 | scat. clouds | cloudy | cloudy | cloudy |
| 1 | scat. clouds | cloudy | scat. clouds | cloudy |
| 2 | scat. clouds | cloudy | cloudy | cloudy |
| 3 | light clouds | cloudy | cloudy | overcast |
| 4 | light clouds | cloudy | cloudy | cloudy |
| 5 | light clouds | cloudy | cloudy | overcast |
| 6 | light clouds | cloudy | cloudy | overcast |
| 7 | light clouds | clouds in hor'n | cloudy | cloudy |
| 8 | scat. clouds | clouds in hor'n | cloudy | clouds in hor'n |
| 9 | scat. clouds | clouds in hor'n | cloudy | clear |
| 10 | light clouds | cloudy | cloudy | clear |
| 11 | scat. clouds | cloudy | cloudy | clouds in hor'n |
| 12 | scat. clouds | clouds in hor'n | scat. clouds | clouds in hor'n |
| 13 | scat. clouds | clouds in hor'n | scat. clouds | clouds in hor'n |
| 14 | scat. clouds | clouds in hor'n | clouds in hor'n | clouds in hor'n |
| 15 | scat. clouds | clouds in hor'n | clouds in hor'n | clouds in hor'n |
| 16 | scat. clouds | clouds in hor'n | clouds in hor'n | clouds in hor'n |
| 17 | light clouds | clouds in hor'n | clouds in hor'n | cloudy |
| 18 | light clouds | clouds in hor'n | scat. clouds | cloudy |
| 19 | light clouds | clouds in hor'n | scat. clouds | cloudy |
| 20 | light clouds | clouds in hor'n | scat. clouds | overcast |
| 21 | light clouds | scat. clouds | scat. clouds | overcast |
| 22 | light clouds | cloudy | scat. clouds | cloudy |
| 23 | light clouds | cloudy | scat. clouds | overcast |

In vol. xxx, pp. 80–82, of this Journal, observations are published showing an unusual disturbance of the magnetic instruments throughout the whole of the Russian empire, but no mention is made of any aurora. The preceding observations show that during this period the sky was generally overcast at each of the Russian stations.

6. *Observations of the Aurora of Aug. 28th and 29th*, 1859, *made in Australia; furnished by* Mr. JAMES GLAISHER, of the Greenwich Observatory.

A. Observations at Hobarton, lat. 42° 52′ S., long. 147° 27′ E.

Aug. 29th, from $6^h\ 55^m$ to $7^h\ 25^m$ P. M. there appeared a most brilliant aurora extending from W. by N. to the eastern part of the horizon in one continuous arc of about 190°, and shooting up to the zenith. The eastern and western extremities of the conoid were of a pale ruby and deep red color, intermixed through the whole vault with bands of pale yellow and shades of dark and light green, and with here and there a small dark cloud jutting in; elsewhere the circumpolar stars glittered like diamonds set in an emerald and ruby ground. The phenomenon had for 30 minutes a most magnificent appearance, the bands being in complete repose, forming a truncated cone of glory, the apex of which, if projected, would have terminated in the zenith. This brilliant storm appeared again about $9^h\ 30^m$ P. M., flickering in brisk coruscations of most beautiful color from the horizon to the zenith.

A second display of the aurora appeared on the night of Sept. 2d, equally brilliant and extensive and less transitory. From midnight to 1 A. M. the aurora broke out into flickering streamers and coruscations, forming in the zenith a well defined corona, which shortly after became diffused and then dispersed.

B. Observations at Cape Otway, lat. 30° 51′ S., long 143° 50′ E.

Aug. 29th. Aurora most magnificent at $6^h\ 30^m$ P. M. and continued visible until after 2 A. M., displaying itself in the form of a rainbow, the arc extending to about 60° or 70°. First color above the horizon a light blue with a tint of green, blending into second, a very light yellow, again blending into third, a deep red.

C. Observations at Portland, lat. 38° 20′ S., long. 141° 55′ E.

Aug. 29th. Aurora visible at $6^h\ 40^m$ P. M. At 7 P. M. a bright band partly tinged with blue and pink, extending E. and W., pink rays converging to a centre on the band a little to the W. of the Milky Way. Gradually faded, and all disappeared by 8 P. M.

D. Observations at Melbourne Observatory, lat. 37° 49′ S., long 145° 9′ E., by GEORGE NEUMEYER.

On the evening of Aug. 28th great disturbances made themselves manifest in all the three magnetic elements, which became less violent during the early part of the morning of the 29th. At 4 A. M. Aug. 29th, the horizontal intensity was 0·0020 below the mean for the previous ten days, and then increased until $8^h\ 50^m$ A. M. when the disturbances assumed so violent a character that the intensity at times, and the inclination very frequently, could not be registered, the scales being out of the

field of the telescope. At $8^h\ 57^m$ A. M. the horizontal intensity was 0·0284 below the mean above referred to, showing a decrease of 0·0264 in the space of one hour. The variation of the needle underwent similar changes, decreasing rapidly until $9^h\ 35^m$, when it was 36 minutes below the mean for the ten days mentioned above. After 8 A. M. the magnetic instruments were registered every minute. The following table contains the means for declination and horizontal intensity.

| | Declination. | Horizontal intensity. |
|---|---|---|
| Between $7^h$ and $8^h$ A. M. | 8° 24′·20 | 2·36264 |
| " 8 " 9 " | 8 22 ·23 | 2·33677 |
| " 9 " 10 " | 8 8 ·52 | 2·35072 |
| " 10 " 11 " | 8 13 ·00 | 2·34711 |
| " 11 " 12 " | 8 22 ·86 | 2·34983 |
| " 12 " 1 P. M. | 8 34 ·33 | 2·35160 |
| " 1 " 2 " | 8 37 ·54 | 2·35539 |
| " 2 " 3 " | 8 37 ·40 | 2·35755 |
| " 3 " 4 " | 8 38 ·46 | 2·34353 |
| " 4 " 5 " | 8 35 ·83 | 2·35479 |
| " 5 " 6 " | 8 34 ·21 | 2·35412 |

The above figures do not give the greatest range; that for declination being 1° 8′·8; and for intensity 0·03197 of the absolute unit.

At $6^h\ 10^m$ P. M. the first traces of an aurora were observed towards S.E. by S. The luminous appearance increased rapidly, spreading towards S.W.

$6^h\ 40^m$ P. M. A rosy color appearing on the clouds in S.E. and S.W. by W.

$6^h\ 50^m$. Splendid aurora. Red streamers very bright, S.E., S.W., and W. by S. visible to an altitude of 50° or 90°. One very bright whitish streamer in S.W. by S. looking as if there were a thin red curtain before a beautiful white luminous curtain. Lower edge about 12° above the horizon. Well defined in S. by W. and S.S.W.; upper portion scarce visible at 45°. The folds of the luminous curtain and the red streamers, if produced, would probably meet one another about 10° S. of the zenith.

$7^h\ 15^m$ P. M. Aurora fading away. Red patch in S.

$7^h\ 20^m$ P. M. Red color disappearing from S. to S.W. giving place to white; at the same time the white in S.S.E. becoming reddish.

$7^h\ 21^m$ P. M. Sky in south becoming very bright and white. Low bank of well defined cumulo-stratus 5° to 6° above the horizon.

$7^h\ 23^m$ P. M. A well defined arch of white light 10° to 12° high above the bank of cloud before mentioned, extending from S.S.E. to W.S.W. being brightest in W.S.W.

$7^h\ 30^m$ P. M. Very faintly red in S.E. Two pink streamers. Two whitish streamers, one in the zodiac, and the other through the cross.

$7^h\ 34^m$ P. M. Faint rosy light in E.S.E. nearly as high as the zenith.

$7^h\ 43^m$ P. M. White streamers in S.W. by W.

$7^h\ 49^m$ P. M. A large patch of very bright light in S.E., white below, reddish above.

$7^h\ 50^m$ P. M. A white luminous cloud appearing in S.W. About 30° high, below the southern cross, a rosy streamer in S.E. by E. very faint.

$7^h$ $55^m$ P. M. The white and red light in S.E. increasing in brightness, yellowish white below, and red above. Top 40° high.

$8^h$ $3^m$ P. M. Luminosity in S.E. almost gone, especially the red.

$8^h$ $20^m$ P. M. Rosy arc from E.S.E. to W. by N., passing nearly through the zenith.

$9^h$ $50^m$ P. M. Three red streamers in S.E. very bright, and several white ones in S.W.

$12^h$ $15^m$ A. M. Bright broad streamers S.S.W. to S.W. partly covered with clouds.

$12^h$ $40^m$ A. M. Luminosity in S. and S.W. 25° high.

$2^h$ $15^m$ A. M. Luminosity from S.S.E. to W., brightest in S.S.W.

The magnetic disturbances continued with more or less intensity until 4 A. M. Aug. 30th.

During the whole of the 29th the instruments of the electric telegraph were disturbed to such a degree as to interfere with the working of the lines extending over New South Wales, Adelaide and Victoria. This effect was similar to that produced by atmospheric electricity.

E. Observations at Ballaarat, lat. 37° 36′ S., long. 143° 51′ E.

Aurora visible Aug. 29th at $6^h$ $45^m$ P. M. It gradually spread to the east and formed a magnificent arch, the colors of which were red, green and violet. The rays of light were distinct and beautiful. The southern portion of the sky was illuminated until $7^h$ $30^m$ sufficiently to cast a shadow.

F. Observations at Longwood, lat. 36° 54′ S., long. 145° 41′ E.

At $6^h$ $10^m$ P. M. Aug. 29th, an aurora appeared from a dusky line in the S.W. part of the horizon, which gradually ascended with a tremulous motion towards the zenith, assuming all shapes and varieties of color, from a pale red or yellow, to a deep vermillion, and extending to the N.E., serving to illuminate the earth, until its disappearance at $7^h$ $15^m$ P. M.

G. Observations at Sandhurst, lat. 36° 48′ S., long. 144° 24′ E.

Aurora very brilliant from 7 P. M., Aug. 29th, until a little after midnight.

H. Observations at Beechworth, lat, 36° 22′ S., long. 146° 52′ E.

Aug. 29th. Aurora visible for nearly an hour and a half, commencing about $5^h$ $45^m$ P. M., gradually increasing in beauty and brilliancy of tint until shortly before $7^h$, when the rays became gradually indistinct, disappearing at about $7^h$ $15^m$ P. M. During the whole day the telegraph wires were strongly affected.

I. Observations at Sydney Observatory, lat. 33° 52′ S., long. 151° 12′ E., made by W. Scott.

The aurora was first noticed, Aug. 29th, at $7^h$ $20^m$ P. M. and continued visible for about half an hour, when it gradually faded away, and the sky became rapidly covered with clouds. I was in the act of observing a transit of the Pole star, when I was struck with the redness of the southern sky. On looking out I was surprised to find a considerable portion of the southern sky in a glow of red light, similar to that which sometimes precedes the rising of the sun. This red light formed a tolerably regular arch from E.S.E. to W.S.W., extending in depth from the south pole to within a few degrees of the horizon. There was a partial break to the S.S.W., and in some places there were radiating streams of light brighter and of a lighter red than the rest.

About 10 A. M., Aug. 29th, the wires of the electric telegraph were seized with an unaccountable fit of restiveness. They did not altogether refuse to work, but acted irregularly, the adjustment of the instrument altering so frequently that it was almost impossible to get any continuous message through. This state lasted until the evening, when the wires began to work better.

From the preceding observations, and from those which have been heretofore published in this Journal, it appears that the remarkable auroral display which prevailed throughout a large portion of the northern hemisphere from Aug. 28th to Sept. 4th, 1859, was accompanied by a display about equally remarkable in the southern hemisphere; and the periods of greatest brilliancy were nearly cotemporaneous in both hemispheres. In order to determine whether such a coincidence is a common occurrence, I have sought for some long and continuous record of the aurora in the southern hemisphere. The most complete record of this kind which I have found is that made at the British magnetic observatory at Hobarton, on Van Dieman's Island during the years 1841–48. These observations have been published by the British Government, and the first part of the following table contains all the instances of auroral exhibitions which I have been able to find in these volumes.

The second part of the table contains the corresponding observations made at New Haven by Mr. E. C. Herrick, who kept a careful record (negative as well as positive,) of all auroral phenomena from 1837 to 1853, except from Mch. to Sept. 1851.

The third part of the table contains auroral notices from the State of New York, as published in the annual Regents' Reports; and the fourth part of the table contains auroral notices from the Toronto meteorological observations.

I. *Observations of the Aurora at Hobarton, Van Dieman's Island*, lat. 42° 52′ S.
long. 147 27 E.
Magnetic Dip in 1845 . . . . 70° 35′·6.

| Hobarton mean time, Astronomical reckoning. | | Notices of Auroras. |
|---|---|---|
| Day. | Hour. | |
| 1841. March 16, | 17 *h.* | Slight appearance of Aurora. |
| March 22, | 15 | Faint appearance of Aurora. |
| May 17, | 13 | Slight appearance of Aurora. |
| July 20, | 9 | Aurora very brilliant in S.E. |
| Dec. 17, | 11 | Slight Aurora in south. |
| 1842. Jan. 1, | 11 | Appearance of Aurora to the south. |
| Feb. 2, | 9 | Slight appearance of Aurora in S.W. |
| Feb. 18, | 9 | Appearance of Aurora ln the south. |
| April 11, | 9 | Slight appearance of Aurora in the south. |
| April 13, | 13–15 | Aurora in the south. |
| April 14, | 9 | Aurora in the south. |
| April 15, | 9 | Aurora in the south. |
| May 16, | 9–15 | Aurora from S.E. to S. |
| June 13, | 11 | Faint Aurora in the south. |
| July 2, | 7–11 | Slight Aurora in the south. |
| Sept. 2, | 13 | Steady bright light in the S. |
| Dec. 31, | 9 | Slight Aurora in the south. |

*Table continued.*

| Hobarton mean time, Astronomical reckoning. | | Notices of Auroras. |
|---|---|---|
| Day. | Hour. | |
| 1844. April 16, | | Aurora in the evening and night. |
| April 25, | 9 | Faint appearance of the Aurora. |
| 1846. Sept. 22, | | Aurora very brilliant throughout the night. |
| 1847. April 20, | | Aurora very distinct during the night. |
| April 21, | | Aurora visible. |
| Sept. 24, | | Aurora very bright. |
| Sept. 25, | | Aurora visible. |
| Sept. 26, | | Aurora visible. |
| Oct. 22, | | Aurora visible and very brilliant. |
| Oct. 23, | | Aurora visible. |
| Oct. 24, | | Aurora still visible. |
| Dec. 20, | | Aurora visible. |
| 1848. March 24, | | Aurora very distinct at night. |
| April 6, | | Aurora very distinct at night. |
| Oct. 18, | | Aurora visible. |
| Nov. 19, | | Aurora visible. |
| Dec. 21, | 10 | Slight signs of Aurora to the south. |

II. *Observations of the Aurora at New Haven*, lat. 41° 18′ N., long. 72° 55′ W.
Magnetic Dip in 1844 . . . . 73° 21′.

| Date. | | Notices. |
|---|---|---|
| 1841. | March 16, | Snowing. |
| | March 21, | 10·45 P. M., faint Aurora; 22d, cloudy. |
| | March 23, | 10 P. M., Aurora with streamers. |
| | May 17, | Clear. No Aurora seen up to $10^h\ 15^m$. |
| | July 19, | 10 P. M., Aurora with streamers; 20th, clear. No Aur.—$10^h\ 15^m$. |
| | July 21, | 10 P. M., Aurora. |
| | Dec. 17, | Overcast. |
| 1842. | Jan. 1, | Clear. No Aurora up to $10^h$. |
| | Feb. 2, | Somewhat hazy. No Aurora up to $10^h\ 30^m$. |
| | Feb. 18, | Overcast. |
| | April 11, | Aurora with streamers. |
| | April 13, | Raining. |
| | April 14, | 10 P. M., Aurora reaching 20° altitude. |
| | April 15, | 3 A. M., Aurora reaching 45° altitude. |
| | May 16, | Hazy: moonshine; no Aurora up to $10^h$. |
| | June 13, | Raining. |
| | July 2, | Overcast. |
| | Sept. 2, | 8·30 P. M., Aurora with streamers. |
| | Dec. 31, | Clear. No Aurora up to $11^h$. |
| 1844. | April 16, | Overcast. |
| | April 25, | Overcast. |
| 1846. | Sept. 21, | Aurora; 22d, 8 P. M., Aurora. |
| 1847. | April 20, | Overcast. |
| | April 21, | Overcast. |
| | Sept. 24, | Raining. |
| | Sept. 25, | Raining. |
| | Sept. 26, | Raining. |
| | Oct. 22, | Overcast. |
| | Oct. 23, | Overcast. |
| | Oct. 24, | Raining. |
| | Dec. 20, | 5 A. M., grand Auroral display. |
| 1848. | March 24, | 8 P. M., Aurora with streamers. |
| | April 6, | 9·30 P. M., Aurora with streamers. |
| | Oct. 18, | Raining. |
| | Nov. 19, | 8 P. M., Aurora. |
| | Dec. 21, | Snowing. |

III. *Observations of the Aurora at the Academies in the State of New York.*
Magnetic Dip from 73° to 75°.

| Date. | | Notices. |
|---|---|---|
| 1841. | March 16, | Aurora seen at Fredonia. |
| | March 22, | Aurora at Newberry, Vt. |
| | July 20, | Aurora seen at St. Lawrence. |
| 1842. | Feb. 1, | Aurora seen at Cortland. |
| | April 11, | Aurora at Albany, Rochester, and many other places. |
| | April 12, | Aurora at Malone. |
| | April 14, | Aurora at Albany and many other places. |
| | April 15, | Aurora at Rochester and many other places. |
| | June 13, | Aurora at Ellisburgh. |
| | July 2, | 10 P. M., Bright Aurora at several places. |
| | Sept. 2, | Aurora at North Salem. |
| 1844. | April 17, | Aurora at Onondaga. |
| 1846. | Sept. 21, | Aurora at North Salem and several other places. |
| | Sept. 22, | Aurora at Onondaga. |
| 1847. | Oct. 23, | Aurora at Rochester and Casenovia. |
| | Oct. 24, | 3 A. M., Brilliant Aurora at Rochester. |
| | Dec. 20, | Aurora at Hamilton and Mexico. |
| 1848. | March 24, | Aurora at New York, Fredonia, and many other places. |
| | April 6, | Brilliant Aur. at Albany, Rochester, and many other places. |
| | Nov. 18, | morning. Splendid Aurora at New York. |

IV. *Observations of the Aurora at Toronto*, lat. 43° 40′ N., long. 79° 28′ W.
Magnetic Dip in 1845 . . . . 75° 15′.

| Date. | | Notices. |
|---|---|---|
| 1841. | July 19, | Aurora from $9^h$ to $13^h$. |
| | Dec. 17, $14^h$. | Faint auroral light in north. |
| 1842. | Feb. 18, | Rain and snow. |
| | April 10, $14^h$. | Bright bank of auroral light in N. |
| | April 14, $14^h$. | Brilliant Aurora. |
| | April 15, $8^h$. | Aurora visible from $8^h$ to $14^h$. |
| | July 3, $14^h$. | Brilliant Aurora. |
| | Sept. 2, $9^h$. | Faint auroral light at $9^h$ and $10^h$. |
| | Dec. 31, | Snow. |
| 1844. | April 16, | Auroral light. |
| | April 25, | Rain. |
| 1846. | Sept. 21, | From $9^h$ to $17^h$ brilliant Aurora. |
| 1847. | April 19, | From $13^h$ to $16^h$ Auroral light in N. |
| | April 21, | Rain. |
| | Sept. 24, | Rain. |
| | Sept. 25, | Rain. |
| | Sept. 26, | Rain. |
| | Oct. 22, $16^h$. | Remarkable appearance of Aurora. |
| | Dec. 19, $17^h$. | Aurora. Great magnetic disturbance. |
| 1848. | March 24, | From $9^h$ to $12^h$ Aurora. |
| | April 5, | From $10^h$ to $15^h$ Aurora. |
| | Oct. 18, | Auroral light through the clouds. |
| | Nov. 19, | Slight auroral light. |
| | Dec. 21, | Snow. |

Part first of the preceding table contains a list of 34 auroras observed at Hobarton. Part second of the table shows that in 11 of these cases an aurora was seen on the same day at New Haven. These observations were not strictly cotemporaneous, for Hobarton and New Haven being in nearly opposite longitudes, when an aurora was seen at Hobarton it could not be seen at New Haven on account of the presence of the sun. Moreover, the New Haven observations were chiefly made in the early part of the night; but in 11 cases an aurora was seen within about 12 hours of its appearance at Hobarton. In several

cases when an aurora was seen at Hobarton it was cloudy at New Haven, and there were eight other corresponding cases in which an aurora was seen at some one of the Academies in New York, although not noticed at New Haven. In four additional cases an aurora was seen at Toronto, when none was recorded at New Haven or in the State of New York.

There remain then only 11 cases of auroras at Hobarton for which we do not find corresponding observations from one of these three sources in the northern hemisphere, and in eight of these cases the sky was overcast from New Haven to Toronto. The following are the dates of these auroras, and opposite to the dates I have placed notices of auroral or magnetic phenomena from some station in the northern hemisphere.

| Date. | |
|---|---|
| 1841. May 17, | Unusual magnetic disturbance at Greenwich, Eng. |
| 1842. Jan. 1, | Unusual magnetic disturbance at Greenwich. |
| Feb. 18, | Unusual magnetic disturbance at Greenwich.<br>Aurora at Christiana, Norway. |
| May 16, | Unusual magnetic disturbance at Toronto and Greenwich. |
| Dec. 31, | Magnetic disturbance at Greenwich. |
| 1844. April 25, | Unusual magnetic disturbance at Philadelphia and Toronto. |
| 1847. April 21, | Unusual magnetic disturbance at Greenwich. |
| Sept. 24, | Aurora $9^h$ to $10^h$ at Greenwich. |
| Sept. 25, | Unusual magnetic disturbance at Greenwich. |
| Sept. 26, | Unusual magnetic disturbance at Greenwich.<br>Aurora at Carlisle, England. |
| 1848. Dec. 21, | Aurora in Newfoundland. |

It thus appears that in every instance when an aurora was observed at Hobarton, an aurora was seen on the same day in the northern hemisphere; or there were observed unusual disturbances of the magnetic instruments, indicating the existence of an aurora at no very remote station. So far then as a conclusion is authorized from so small a number of observations, we should infer that whenever an aurora is seen at Hobarton, where the magnetic dip is $-70°$, an aurora occurs at some place in the northern hemisphere as far south as where the magnetic dip does not much exceed 75°; in other words, an unusual auroral display in the southern hemisphere is *always* accompanied by an unusual display in the northern hemisphere. As any cause which affects the intensity of the magnetism at one pole of a magnet, usually affects the other pole, so an exhibition of auroral light about one magnetic pole of the earth, is uniformly attended by a simultaneous exhibition of auroral light about the opposite magnetic pole.

New Haven, May, 1861.