Thunder-storms by districts; August, 1886.

District.	State.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	Total.
I	Connecticut														2															1		1	4
	Maine	1	1					1		1		3			1					1											1		10
	Massachusetts		1			1	1					3	7		12															2		2	29
	New Hampshire	2				1						2																				1	6
	New York	17	2									9		12	5		11													9	12	2	79
	Rhode Island								1						3																		4
	Vermont	4	2									7		1	5																		19
	Total	24	6			2	1	1	1	1		24	7	13	28		11			1										12	13	6	151
II	Delaware																																0
	Maryland	6					1							3				2										1	1		8		22
	New Jersey	3	2			2	1					4			5		2												1	5	2	1	28
	North Carolina		1				3					2	4	7	3	3		7	7	1						1	2	1	1	1			45
	Pennsylvania	10			1	3		2			1	1		5	2		3												1	2	5	2	38
	Virginia / West Virginia	7				2	6	5		2	1	1	7	8	6	1	1	9	4			1	1	1		3	1	2	6	6	7	1	89
	Total	26	3		1	7	11	7		2	2	8	11	23	16	4	6	18	11	1	1	1	1	1		4	3	4	10	14	22	4	222
III	Illinois	9	1		1	6	10					10	21	18	4	13	8	9	8			2	3					2	12	19	1		157
	Indiana	11					12					8	18	18	8	5	24	11	2	1		2	18	2				3	14	19	1		177
	Kentucky						3						2	1	1	1		1	1				1			1			1	1			14
	Ohio	123	3		4	10	53	2	3	3	1	74	81	103	89	9	199	20			1	22	144	12		5	1	2	26	83	28	1	1,102
	Tennessee	5				1	5						4			5		7	4	2	2		7	9	6	1	2	8	7	6	4	1	86
	Total	148	4		5	17	83	2	3	3	1	92	126	140	102	33	231	48	15	3	3	26	173	23	6	7	3	15	60	128	34	2	1,536
IV	Michigan	3					1						3	10		3	7	2			2	14	3					4	9	8			69
	Minnesota					1			1	4	1	4	1	2		6				2	1	5					1	1					30
	Wisconsin	1			3	1	3					1	1	4		3	7				6	10	1				1	2	7	1			52
	Total	4			3	2	4		1	4	1	5	5	16		12	14	2		2	9	29	4				2	7	16	9			151
V	Dakota				3	2		2		4	3	1	4	2	5	6				1	1	1				3							38
	Iowa	10	1		10	34	6	1	22	11	17	67	79	70	25	46	26	18	2	7	3	16				1		20	40	7	1	1	541
	Nebraska	1	3	1	1	3		1	3	6	5	3	3	6	1	1	3	3		1		1						1	1				48
	Total	11	4	1	14	39	6	4	25	21	25	71	86	78	31	53	29	21	2	9	4	18				4		21	41	7	1	1	627
VI	Arkansas	2		1			1				1	1																2	2	2			12
	Indian Territory				1	1				1										1		1				1		1					7
	Kansas	2	2	7	2	12			6	7	10	2		1	4	1	3	4			1		1			1	5	12	6	3		5	97
	Missouri	2		3	1	2					7		3	2	1	3	4	8	2				2					5	2	2			49
	Total	6	2	11	4	15	1		6	8	18	3	3	3	5	4	7	12	2	1	1	1	3			2	5	20	10	7		5	165
	Grand total	219	19	12	27	82	103	14	36	39	47	203	238	273	182	106	298	101	30	17	18	75	181	24	6	17	13	67	137	177	70	18	2,852

CHART OF ELECTROMETER READINGS.

[By Prof. T. C. MENDENHALL, Assistant.]

Observations have been made during the month of August, as usual, at all stations.

At Boston, Massachusetts, negative indications occurred on the following dates: 1st, 3d, 4th, 5th, 9th, 12th, 14th, 16th, 25th, and 30th. Rain occurred during night of 1st; afternoon of 3d; during night of 5th; during night of 7th; during afternoon of 12th; morning of 14th; and afternoon of 30th. The morning of the 25th was cloudy and threatening. The only date during the month on which rainfall was not accompanied or preceded by negative indications was August 7th. This was a foggy and damp day with fresh east winds, and was characterized by unusually high positive potentials.

At Ithaca, New York (Cornell University), negative values occurred on the 1st during thunder-storm; on the 3d, following rain; on the 2d; on the 5th, preceding rain several hours; on the 7th, following rain; on 16th, preceding rain; and on 17th, unaccompanied by rain. A very severe thunder-storm occurred on the evening of the 11th, not preceded by any unusual indication. A severe thunder-storm occurred on the 16th in which the indications were throughout positive, ranging from 152 to 2,625 volts.

The first diagram of chart vi represents a series of mean values for that part of the day between 9 a. m. and 3 p. m., obtained in the following way: All dates of thunder-storms and abnormal variations are omitted in this discussion of mean values, as it is evident that the great values obtained at these times would either masque or distort the diurnal variation due to more regular causes. Groups of five days are taken, and the mean of each of the four daily observations determined. This, in the case of Washington City, is represented by the line numbered 1; the mean observations made on June 29th, 30th, July 3d, 4th, and 5th; intervening dates being omitted for the reasons above stated. The mean values for the 9 and 11 a. m., 1 p. m., 3 p. m. observations were, 138, 126, 138, and 114 volts, respectively. Similarly for the 6th, 7th, 8th, 10th, and 16th, the curve numbered 2 represents the mean values 92, 95, 100, and 91 volts. For the 17th, 18th, 20th, 22d, and 24th, curve numbered 3 represents 75, 91, 102, and 109 volts; and for the 26th, 27th, 28th, and August 4th and 5th, curve numbered 4 represents 78, 90, 99.6, and 107 volts. The mean of these values, in turn, is represented by the dark-lined curve numbered 5. The values are 76.6, 80.4, 85.0, and 84.0; or, for this time and locality, the curve seems to show a steady rise during the forenoon, reaching a maximum about the early part of the afternoon.

The second diagram on chart vi. represents a like determination for Boston, Massachusetts. Observations are made here at the Massachusetts Institute of Technology, and for many reasons we ought not anticipate any striking correspondence. Curve number 1 represents the mean of the observations made on June 29–30th, July 1st, 2d, 3d, giving as values—minus 8.9, minus 11.9, minus 7.6, and plus 18.3. From the 4th to the 8th, inclusive, the values are throughout on the negative side, 13.7, 12.8, 16.9, and 15.4. From the 9th to 13th, inclusive, the values are positive, 9.6, 7.8, 6.3, and 6.2, represented by curve numbered 3. Curve numbered 4 gives the values from the 14th to the 18th, inclusive, viz., 5, 10, 26.2, 14.2; curve numbered 5, the values from the 18th to the 23d, 65.5, 90.7, 128.2, and 125.1, and curve numbered 6, the values of the 24th, 25th, 26th, 27th, and 29th, minus 1.3; plus 43.8, 44.5, 54.3. The mean for the month is represented by the curve numbered 7, representing the following mean values for the four observations at 9 and 11 a. m. and 1 and 3 p. m., 9.4, 21.3, 29.6, 33.8, respectively.

The third portion of the first diagram of chart vi gives the values, obtained in the same way, for New Haven, Connecticut. From June 24–29th, the mean values are 9.4, 8.2, 9.0, and 8.6; from June 30th to July 5th, 11.6, 15.8, 8.6, 8.8; from July 6th to 10th, represented by curve numbered 3, 9.4, 15.4, 8.6, 9.0, from July 12th to 17th, represented by curve numbered 4, 12.0, 7.0, 5.8, 12.0, and from 19th to 24th, omitting the 21st,

9.6, 9.4, 7.0, and 8.4. The total mean for the month, represented by curve 6, 10.4, 11.1, 7.8, and 9.3.

The second diagram of chart vi represents the potential variations at Boston, Massachusetts, during the passage of a light thunder-storm, about four miles to the southwest of the place of observation, August 3d, 1886.

The following is abstracted from the observer's report:

Time.	Volts.	Remarks.	Time.	Volts.	Remarks.
P. M.			*P. M.*		
1.00	+ 20	Storm in sw.; wind from sw.	2.08	+ 85	
			2.10	+105	
1.02	+ 40		2.12	+ 60	
1.04	+ 10		2.14	+ 55	
1.06	— 8	Brisk; weather fair at Boston.	2.16	+ 45	
			2.18	+ 50	
1.08	+ 20		2.20	+ 65	
1.10	+ 15		2.22	+ 55	
1.12	+ 40		2.24	+ 34	
1.14	+ 50		2.26	+ 58	
1.16	+ 52		2.28	+ 65	
1.18	+ 61		2.30	+ 40	
1.20	+ 20		2.32	+ 80	
1.22	— 38		2.34	+ 75	
1.24	+ 75	Cloud passing overhead.	2.36	+ 55	
			2.38	+ 55	
1.26	+114		2.40	+ 45	
1.28	+140		2.42	+ 20	
1.30	+168		2.44	+ 5	
1.32	+151		2.46	— 25	Heavy clouds overhead.
1.34	+ 80				
1.36	+ 40		2.48	— 17	
1.38	+ 40		2.50	— 20	
1.40	+ 48		2.52	— 20	
1.42	+ 40		2.54	— 2	
1.44	+ 10		2.56	+ 10	Very light rain began 2.56, ended 2.57 p. m.
1.46	— 41				
1.48	+ 37				
1.50	+ 35		2.58	— 2	Rain from a single cloud.
1.52	+ 50				
1.54	+ 48		3.00	—120	
1.56	+ 30		3.02	— 60	
1.58	+ 25		3.04	+ 15	Light rain.
2.00	+ 20		3.06	+ 15	Rain ended.
2.02	+ 10		3.08	+ 15	
2.04	+ 60		3.10	+ 15	Clear; .2 cum. strat. clouds.
2.06	— 20				

The third diagram of chart number vi represents the conditions observed at Ithaca, New York, during passage of a thunder-storm. The values obtained at this station, owing to the altitude of the place and the exposure, are always greatly in excess of those obtained elsewhere.

The following table is abridged from the observer's report of special observations made during the storm of August 1, 1886:

Time.	Volts.		Remarks.
P. M.	*Plus.*	*Minus.*	
2.53 00			First thunder heard; wind, southwest brisk; storm west of station, moving north.
3.03 00	265		
3.04 00	220		
3.05 00	140		
3.06 00	75		Very distant thunder heard.
3.07 00		35	
3.08 00		150	Continuous rumbling; distant storm, northwest of station.
3.09 00		350	
3.10 00		550	
3.11 00		700	
3.12 00		880	
3.13 00		940	
3.14 00		980	
3.15 00		970	Storm in northwest.
3.16 00		960	
3.17 00		960	Thunder heard.
3.18 00		953	
3.19 00		955	
3.20 00		962	
3.21 00		945	
3.22 00		955	Thunder heard.
3.23 00		965	Continuous rumble.
3.24 00		965	Another storm in west; very distant, but coming towards station.
3.25 00		950	
3.26 00		945	
3.27 00		1005	Loud thunder.
3.28 00		980	
3.29 00		977	
3.30 00		1000	Storm in southwest.
3.31 00			Rain commenced.
3.32 00		1010	
3.33 00		1250	
3.34 00			Off scale negative.
3.39 00	600		
3.40 00	900	7500(?)	Sudden oscillation of needle.
3.41 00			Thunder heard.
3.42 20			Thunder heard.
3.43 00		1500	
3.43 10		900 to 7500(?)	
3.43 30			Thunder heard.
3.43 55		3000, 6300, 7500	Needle swinging.
3.44 10			
3.45 00			Off scale negative.
3.46 00		1200	
3.47 00	900		
3.48 15	1200	2100	
3.48 30			Thunder heard.
3.49 00			Wind in gusts.
3.50 00	00		Heavy rain.
3.50 55	2400		
3.51 20		1800	
3.51 50			Thunder heard.
3.52 00	900		
3.53 00		300	High wind and rain.
3.53 30	00		A lull in storm.
3.54 00	900		
3.55 00		600	Wind in gusts.
3.55 55		3900, 900	Heavy rain.
3.56 15		2100, 00	Heavier rain.
3.57 15	600	3900	
3.58 00		4800, 1500	Wind southwest; heavy wind and rain.
3.59 00	900		
4.00 00		1800	
4.00 07	1500		
4.00 25			Thunder heard.
4.01 00		1800	
4.02 00		1200	
4.03 00		2100	
4.03 10	3900		
4.03 27			Thunder heard.
4.04 00		2100, 900	
4.05 00		3000	
4.06 00	1500		
4.07 00	1500		
4.08 00		1200	
4.08 40	3000		
4.08 50			Thunder heard.
4.09 00	1200		
4.10 00		1800	
4.10 05	900		Thunder heard.
4.10 30	2400		Thunder heard.
4.11 00		1200	
4.11 15	3900		Lightning simultaneous with oscillation.
4.11 25			Loud thunder.
4.12 00		2100	Rain diminishing.
4.12 55	1500		
4.13 10		1500	Thunder-storm.
4.15 00	00		
4.16 00		900	

Time.	Volts.		Remarks.
P. M.	*Plus.*	*Minus.*	
4.17 00	2400		Thunder heard.
4.18 00	600		
4.19 00	2000		
4.19 10	1500	1200	
4.19 30	00		Thunder heard.
4.20 00		900	
4.21 00	1800		
4.23 00	3900		
4.24 00	2400		Rain diminishing.
4.24 15	2100	2700	
4.24 30			Thunder heard.
4.25 00	2700		
4.26 00	300		
4.27 00		300	Raining hard.
4.28 00		1080	
4.29 00		750	Clearing.
4.30 00	1500		
4.31 00	300		Rain ended.
4.32 00		450	
4.33 00	210		

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos were observed in the various states and territories, as follows:

Alabama.—Mobile, 2d.
Arizona.—Yuma, 5th, 28th; Prescott, 28th.
California.—San Diego, 1st, 6th, 8th, 11th, 28th.
Colorado.—Montrose, 22d.
Florida.—Archer, 1st, 31st; Key West, 26th, 28th.
Georgia.—Savannah, 29th, 31st.
Illinois.—Pekin, 1st, 23d, 29th; Riley, 3d, 6th, 9th, 19th.
Indiana.—Indianapolis, 3d; Vevay, 5th, 21st.
Iowa.—Corydon, 9th; Cedar Rapids, 18th.
Kansas.—Manhattan, 5th, 17th; Yates Centre, 8th, 20th; Wyandotte, 23d, 24th, 26th, 29th, 30th, 31st.
Maine.—Orono, 16th.
Massachusetts.—Blue Hill Observatory, 4th; Provincetown, 16th.
Michigan.—Port Huron, 1st, 20th; Grand Haven, 11th.
Nebraska.—Omaha, 8th.
New Jersey.—Dover, 12th; Clayton, 13th, 24th.
New York.—Oswego, 4th, 5th.
North Carolina.—New River Inlet, 27th, 30th.
Ohio.—Wauseon, 11th, 19th, 20th, 21st.
Pennsylvania.—Erie, 9th; East Brook, 22d.
South Carolina.—Stateburg, 6th, 8th, 11th, 24th; Spartanburg, 31st.
Tennessee.—Nashville, 16th, 17th.
Texas.—Galveston, 2d.
Vermont.—Strafford, 16th.
Virginia.—Variety Mills, 3d, 6th, 24th; Dale Enterprise, 3d, 11th, 21st; Lynchburg, 17th, 19th, 20th, 25th; Rappahannock Station, 21st.
Wyoming.—Fort Bridger, 2d, 30th.

LUNAR HALOS.

Lunar halos were observed in the various states and territories, as follows:

Arizona.—Yuma, 4th, 10th, 11th, 12th.
California.—Sacramento, 17th.
Connecticut.—New Haven, 11th, 17th.
District of Columbia.—Washington City, 7th, 9th, 11th.
Florida.—Archer, 5th, 8th, 9th, 14th, 15th; Jacksonville, 8th, 15th; Key West, 10th, 15th; Limona, 13th; Manatee, 12th, 14th.
Georgia.—Augusta, 6th, 24th; Savannah, 15th.
Illinois.—Pekin, 5th, 9th, 11th, 20th; Riley, 8th, 18th.
Indiana.—Lafayette, 9th.
Iowa.—Independence, 5th, 15th; Cedar Rapids, 19th.
Kansas.—Dodge City and Yates Centre, 8th; Allison and Westmoreland, 10th; Independence, 11th; Wyandotte, 20th.
Kentucky.—Louisville, 10th; Frankfort, 12th, 16th.
Maryland.—Baltimore, 12th.
Michigan.—Lansing, 8th.
Nebraska.—De Soto, 8th, 15th.
New Hampshire.—Nashua, 14th.
New Jersey.—Beverly and Egg Harbor City, 11th; Moorestown, 13th.
New Mexico.—Fort Stanton, 6th, 11th.
New York.—Setauket, 6th, 13th; Ithaca, 9th.
North Carolina.—New River Inlet, 13th; Fort Macon, 17th.
Ohio.—Elyria, 4th; Columbus, 12th to 15th; Napoleon, 13th.
Pennsylvania.—Catawissa, 13th; Pittsburg, 20th.
South Carolina.—Stateburg, 8th, 13th; Spartanburg, 10th, 12th, 14th, 17th, 18th.
Tennessee.—Nashville, 12th, 13th; Chattanooga, 18th; Ashwood, 19th.
Texas.—Cleburne, 3d; Palestine, 5th, 10th; Brownsville and Rio Grande City, 10th.
Virginia.—Dale Enterprise, 7th, 10th, 11th, 20th; Rappahannock Station, 9th to 13th, 15th; Bird's Nest, 9th, 12th, 13th, 15th, 17th; Cape Henry, 13th.
Washington Territory.—Neah Bay, 7th; Tatoosh Island, 8th.
West Virginia.—Parkersburg, 12th.
Wisconsin.—Milwaukee, 12th; Manitowoc, 15th.
Wyoming.—Fort Bridger, 7th.

The phases of the moon (Washington mean time) during August, as given in "The American Ephemeris and Nautical Almanac" for 1886, are as follows: New moon, 28th, 19 h. 46.1 m.; first quarter, 6th, 3 h. 58.0 m.; full moon, 14th, 1 h. 16.0 m.; last quarter, 22d, 2 h. 33.6 m.; apogee, 14th, 20.6 h.; perigee, 28th, 19.9 h.

MIRAGE.

Nicolaus, Sutter county, California: a mirage occurred here on the 9th, distant houses being plainly seen elevated above their usual position.

The following is from the "New York Herald" of August 14, 1886:

> The phenomenon known as mirage was witnessed at 7 a. m. of the 12th at Rondout, New York. In the foreground cattle were seen lazily chewing their fodder, while close by were the farmer's house, barn, and other out-buildings. In the background the picture of a pretty rural scene was presented to the eye. The atmosphere was murky. The spectacle, which was viewed by a number of well known citizens, is said to have been the first of the kind seen in Ulster county within the memory of the oldest inhabitant.

Mirage was observed at other stations, as follows:
Webster, Dakota, 17th, 20th, 21st, 30th, 31st.
Salina, Kansas, 22d, 24th, 26th.
Egg Harbor City, New Jersey, 24th.

MISCELLANEOUS PHENOMENA.

DROUGHT.

Lead Hill, Boone county, Arkansas: very warm weather prevailed from the 12th to the 18th, with dry wind from the southwest, which, combined with the drought, was very damaging to vegetation.

Keokuk, Iowa, 31st: the corn crop on uplands is almost ruined by the drought, although copious rains fell from the 11th to the 18th. These rains were of benefit only to corn that had been planted late in bottom lands.

Fort Sill, Indian Territory: on the afternoon of the 19th a thunder-storm and heavy rain set in. This was the second heavy rain since the beginning of the drought, April 26th, and the prospects for cattle grazing were somewhat brightened. During this storm 1.53 inches of rain fell.

Mackinaw City, Michigan: heavy rain fell on the 21st and 22d, breaking the drought that had continued since the middle of June. Owing to the drought the hay and grain crops have been seriously injured, and mills using water as a power were obliged to cease operations early in July on account of the low water in streams.

Milwaukee, Wisconsin: on the 21st the severe drought which