son and Fort Apache, Ariz., 16th; Camp Grant, Ariz., 17th; Galveston, 2nd; Clarksville, Tex., 28; Memphis, 19th; New Orleans, 2nd, 18th; Key West, 6th, 7th, 8th, 14th; Wilmington, N. C., 6th, 21st; Charlotte, N. C., 5th; Chincoteague, Va., 6th.

OPTICAL PHENOMENA.

Halos have been observed with considerable frequency throughout the month in the various districts. Solar halos, with mock suns, have been rather numerous, but not of as marked brilliancy and perfection as those reported in December, 1880. The following stations report from 2 to 4 mock suns on the dates named: Fort Stevenson, Dak., 20th; Fort Totten, Dak., 6th, 7th, 8th; Spiceland, Ind., 12th; Pierce City, Mo., 22nd; Cheyenne, 26th; Yankton, 4th, 6th, 11th, 12th, 13th; St. Paul, 4th; Dubuque, 2 th; Logansport, Ind., 27th; Bangor, Me., 16th. Nothing of importance was reported in respect to lunar halos, except the following: Clinton, Iowa, very brilliant; four mock moons, and above the body of the halo appeared the inverted arc of a circle. Fort Bennett, Dak, 22nd, 5:20 a. m., very brilliant lunar corona.

Polar Bands.—Prescott, Ariz., 5th; Detroit, 8th; New Corydon, Ind., 2nd, 3rd, 8th, 11th; Glenwood, Iowa, 11th; Yates Center, Kan., 14th, 16th; Gardiner, Me., 11th; Clear Creek, Neb., 11th, 12th; Auburn, N. H., 9th, 20th; Freehold, N. J., 16th; Vineland, N. J., 8th, 12th; Wytheville, Va., 7th, 15th.

Mirage.—Albuquerque, N. M., 8th.

MISCELLANEOUS PHENOMENA.

Meteors.—Punta Rassa, 21st, 10 p. m., quite brilliant; visible about three seconds; course SE. to NW.; disappeared at elevation of about 25° with a long train of incandescent vapor. Springfield, Ill., 1st, 7:48 p. m., large and very brilliant, light sufficient to attract the notice of a person within doors, reading by a coal-oil lamp; was first seen due north at about 25° above the horizon, when it moved downward to a point 47° east and disappeared; motion very slow; no trail or cloud; duration 15 seconds. Cleburne, Tex., 21st, 6:30 p. m., very brilliant. Wytheville, Va., 6th, 6:30 p. m., very brilliant, course S. to N., motion slow until it reached the zenith, when it burst, sending its fragments in every direction, color white; 24th, 8:50 p. m., quite brilliant, rather larger than Mars; started few degrees east of station and moved eastward toward Orion, sinking a little as it passed; no train at disappearance; a few moments later another meteor of splendid bluish-green color, larger than Venus, moved from Cassiopeia towards Saturn, but sunk more rapidly than its predecessor; exploded like a rocket, throwing its fragments in every direction. Woodstock, Vt., 6:45 p. m., quite brilliant; appeared in SW. about 40° above horizon; moved in a northerly direction, leaving a brilliant white train of light visible for about six seconds.

Earthquakes.—Alaska: The following graphic description of a remarkable series of shocks occurring in Sitka Alaska in *October* and *November*, 1880, and which lasted for several days, is taken from the report of a special correspondent of an Oregon paper: "October 26th, 6 to 8 a. m., clear with sun shining 9 a. m., cloudy, high wind 10 a. m., tornado 11 20 a. m., cyclone, thunder, lightning, rain and hail; 1:20 p. m., severe shock of earthquake—oscillations from true east to west. *Incidents.*—Sudden calm; rumbling; earth wave passed; second, severe upheaval with cracking and splitting noise in and beneath the ground; third, slight shock with apparent return wave. The houses of the town were regularly upheaved in the order in which they stood, showing a true wave. Time from first to third about 18 seconds. Short lull, followed by rain, hail and snow. 2:14 p. m., slight shock with little vibration. 8:46 p. m., two shocks coming from the same direction as the first. 27th, 5;35 a. m., mean time, two short and sharp shocks, direction from magnetic east to west; length of shocks and interval unnoted on account of rapidity of movement; oscillation from north to south and very perceptible, followed by snow, hail, rain and high wind. 9:15 p. m., sharp shock from southwest to northeast. 11:04′. 20″ p. m., slight shock, with continued low rumbing for the space of 1 minute and 8 seconds, from east to west. 11.45, same. From 9 to 11, scud flying from southeost to northwest. Stars shining through the break of clouds. *Remarks.*—On Thursday, the 28th, there was no perceptible upheaval, nevertheless the phenomena was peculiar during the afternoon of that day or after meridian. I was under the impression that there was a quivering in the air, yet but few persons noticed the state of the atmosphere. Becoming satisfied that something unusual was in the elements, I watched for an effect; could only discover that nervous persons were seemingly very bouyant and restless, while others, particularly females, complained of loss of appetite, accompanied with a feeling of seasickness, and I thought I noticed a feeling akin to hysteria. Under the impression that I must be mistaken, about 6 p. m. I entered a well lighted saloon and there watched for an indication to relieve my doubts or confirm my opinion. Only one person of the whole number, there being about nine in the room, seemed to be affected. That individual, said to be one of the powerful men in the community, addressed himself to me personally several times, asking what I supposed ailed him; declined to answer the question and went to my present home. Retired for the night at 9 o'clock and 30 minutes; the

quivering sensation continued and seemed to increase; arose at ten, lighted up my room and commenced a series of experiments to determine my status, could make nothing of it; again retired; sleepless, and continued in that state until the upheaval noted on Friday morning. Confirmatory evidence of the peculiar state of the atmosphere on Thursday night and Friday morning I have received from four officers of the U. S. ship *Jamestown*, who were in the mountains hunting, some ten or more miles from here. They occupied a cabin about eight hundred feet above the level of the sea. They informed me that the quivering was so great during the whole night that not one of them could sleep. At six o'clock Friday morning they packed up and returned to the ship. 29th, 1:05 a. m., shock of considerable duration followed by heavy rain and hail. 6:38 a. m., sharp shock with long rumbling sound like distant thunder; oscillation from southeast to northwest: rain. 11:58.′ 30″ p. m., three shocks; first two in rapid succession, the third evidently the return or settling back of the crust of the earth; direction northeast to southwest: oscillation in opposite direction, which I am unable to account for, followed within three minutes by a sudden fall of rain and hail. *Remarks*—Retired at my usual hour, had lain but a few minutes when I became satisfied that we were becoming enveloped by an electric wave or current; dressed myself, lighted a lantern, and walked out of town some half a mile; tried in various ways to satisfy myself that I was correct; proved the fact beyond a doubt by extending my person on the rocks at various points of the compass; viz.: with head to the east and feet to the west the sensation and pressure was regular from head to feet; reverse position, exactly the reverse. At any angle from east to west, I could feel the electric pressure as positive as if a hand was placed on that portion of my body that came in direct contact with the current; yet the most peculiar phenomenon connected therewith was the fact that while lying down I seemed to be drifting north and south and while standing there seemed to be a desire on my part to swing about to the poles. Nov. 13, 5:28 a. m.—Shock from NE. to SE.; rapid, quick movement. Nov. 14, 5:50 a. m.—Two shocks from NE. to SW. The first upheaval sudden and quite sharp, duration about six seconds. Friday night to Saturday noon of above date, very heavy rain storm. Saturday afternoon and night, temperature 50°; high wind, almost a hurricane. On board the ship *Jamestown* the earthquake of the 26th w s so violent that it was compared to striking a rock. On Tihiagreff Island, (north of this island, southeast end, it was very violent. At Hoona village, north end, it threw the Indians around like chips in an eddy. On the southeast end of Admiralty Island it shook things up lively. On the mainland, due east from the last-named island, a friend who was on a quartz prospect, informs me that the "quake," as he called it, threw him on to his head, and I believe him. The Indians here and hereabouts were very much excited. Redoubt Lake, on this island, rose six feet instantly, and fell as quick—measurements by the lodgement of drift. At the warm springs, twenty miles southeast, the invalids who were there tell me that the springs spouted like geysers. Two Russians who were prospecting at Whale Bay, thirty-six miles southeast, told me that the shocks were very severe, and that a tidal wave of huge dimensions ran into the bay, which I think very likely, as it opens broad to the sea." *California:* San Francisco, 24th, three shocks at 8:54, 9:15 and 11:15 p. m., respectively; vibrations NW. to SE.; no damage. Campo, 7th, 6:15 a. m., slight. Red Bluff, 1st, 6:55 p. m., vibrations N. to S.; windows rattled and pendant articles swung to and fro; 6th, 6:25 p. m., vibrations NW. to SE.; upward lifting motion followed by a tremor. Oakland, 24th, three shocks at8:50, 9:20 and 11:17 p. m. respectively; first and second shocks attended by a low, rumbling sound, with vibrations from SW. to NE., all pendant objects swayed backward and forward; third shock attended with heavy concussions, shaking windows and jarring loose articles; vibrations from SW. to NE. *Maine:* Bath, 21st, 9:40 p. m., severe shock; many people startled from sleep; sound appeared somewhat like thunder, faint at first, but gradually increasing in volume, accompanied by a rattling, not like anything else, but somewhat such a noise as if chains were being dragged over bare ground. The noise increased in intensity, houses were felt to vibrate, light ornaments on shelves were seen to move and the climax was reached in a loud, explosive sound, the whole not occupying more than four or five seconds. Some people described the sound as like the rolling of a table or bed on castors, gathering strength as it moved and coming into collision with the wall, with a sudden and loud concussion. Harding's Station, 21st, 9:35 p. m., severe shock; people were startled from sleep by the accompanying noise and vibrations. The shock was also experienced at Woolwick, Phipsburg, Topsham, Richmond and Bowdoinham in Sagadahock Co., to the northward of Bath, and at places in Brunswick township to the westward. *Washington Territory:* Bainbridge Island, five shocks, all slight, with motion tremulous, viz: 5th, 10:56 p. m.; 6th, 4:20 p. m.; 7th, 10:15 p. m.; 16th, 11:00 p. m.; 30th, 9:45 p. m.

Sunsets.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding twenty-four hours have been observed at all Signal Service Stations. Reports from 181 stations show 5,565 observations to have been made, of which 45 were reported doubtful; of the remainder, 4,615 or 83.6 per cent. were followed by the expected weather.

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S Newcomb, U. S. Navy, Superintendent Nautical Almanac Office, Washington, D. C.:

Date—Jan., 1881.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots	
1, 11 a. m.....	0	0	0	0	0	0	4	10	
2, 10 a. m.....	1	1	0	0	1	1	5	11†	
3, 12 m.....	1	2	1	1	1	2	5	12†	Faculæ.
12, 8 a. m.....	0	0	.....	.....	0	0	1	3	Faculæ.
17, 4 p. m.....	3	15†	.....	.....	.....	.....	3	15†	
18, 9 a. m	1	5	0	0	0	0	4	20†	Faculæ.
22, 4 p. m....	0	0	.....	.....	0	0	1	3	Faculæ.
23, 10 a. m.....	1	5	0	0	0	0	2	8	
4 p. m.....	1	12	0	0	1	4	3	20†	Faculæ.
24, 8 a. m.....	0	0	0	0	0	0	3	20†	
26, 9 a. m.....	1	10	0	0	0	0	4	35†	Faculæ.
4 p. m.....	0	5		0	0	0	4	40†	
27, 9 a. m.....	2	10		0	0	0	6	50†	Faculæ.
28, 10 a. m.....	1	5		0	0	0	7	55†	Broad areas of faculæ.
4 p. m.....	0	0		0	0	0	7	55†	
8 a. m.....	1	20	3	20	1	5	5	55†	

† Approximated.

Mr. William Dawson, at Spiceland, Ind., reports: 1st, 5 groups, 11 spots, one large spot close to east edge; air bad. 7th, 1 group, 3 spots, two large spots nearly north of center; air bad. 8th, one group, 4 spots; air very bad. 10th, one group, 6 spots; air bad. 11th, 2 groups, 9 spots, one group 3′ from west edge; the other group with faculæ at east edge; air pretty good. 17th, one group, 2 spots; both large, half way from centre to NW. margin. 24th, 3 groups, 23 spots; two large spots south of centre. 28th, 5 groups, 66 spots; one large spot near west edge; five spots, all very prominent; air good.

Mr. H. D. Gowey, at North Lewisburg, Ohio, says: "Observed sun spots on the 1st, 2nd, 7th, 8th, 10th, 26th and 27th.

Mr. David Trowbridge, Waterburg, N. Y., reports: "No sun spots observed; too cloudy."

NOTES AND EXTRACTS.

[Read before the National Academy of Sciences, New York, Nov. 18, 1880.]

CONTRIBUTIONS TO METEOROLOGY, BEING RESULTS DERIVED FROM AN EXAMINATION OF THE OBSERVATIONS OF THE UNITED STATES SIGNAL SERVICE, AND FROM OTHER SOURCES; BY ELIAS LOOMIS, PROFESSOR OF NAT. PHIL. IN YALE COLLEGE.

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American Storms Advancing in a Southeasterly Direction.—During the colder months of the year, storms while crossing the United States frequently advance, during a portion of their course, in a direction from northwest to southeast. This direction is not confined to any particular section of the country, but occurs most frequently in the region between the Rocky Mountains and the Mississippi River. This course is seldom maintained as far south as the parallel of 30°, and after reaching its most southerly point, the storm frequently changes its course towards the northeast. The following table shows those cases in which storms have advanced towards the southeast as far as the parallel of 28°. The arrangement is similar to that of the preceding table. The first six columns describe each storm as long as its course continued southeasterly; the last column gives some indication of the subsequent course of each storm.

No.	Date.			Latitude. beg. end.	Longitude. beg. end.	Course.	Vel. miles	Subsequent course.
				° °	° °			
1	1871.	Feb.	17.2–18.2	32–27	86– 79	S.E.	21.8	Unknown.
2		April	15.3–16.3	41–26	101– 89	S.E.	21.1	Unknown.
3	1875.	Jan.	15.1–16.2	44–27	106– 91	S.E.	27.1	Unknown.
4	1876.	Feb.	3 – 4.1	33–28	98– 80	S.E.	28.4	Unknown.
5		March	6.2–12.1	47–27	127– 89	S.E.	15.7	Unknown.
6		May	6.3– 7.3	33–27	100– 93	S.E.	25.0	Unknown.
7	1877.	Jan.	4.2– 5.3	46– 8	100– 90	S.S.E.	40.4	N.E.
8		March	21.2–24.1	42–28	100– 95	S.S.E.	22.5	N.E.
9		Dec.	19 –20	44–28	102– 98	S.E.	10.0	N
10		Dec.	22 –27.2	47–27	102– 95	S.E.	29.7	N.E.
11	1878.	Feb.	1.1– 2.3	33–26	96– 84	S.E.	18.3	N.E.
12		Aug.	20.2–24.2	38–22	83– 81	S.S.E.	15.1	Became extinct.
13		Nov.	16.2–17.2	28–24	102– 93	S.S.E.	24.0	N.E.
14	1879.	Jan.	6.3– 7.3	38–27	110– 98	S.E.	39.2	N.E.
15		Jan.	8.3–11.1	49–27	119– 98	S.E.	30.4	N.E.
16		May	4.1– 6.1	34–24	101– 96	S.S.E.	16.1	Became extinct.

We see from this table that the average velocity of these storms while pursuing their course towards the southeast, was twenty-four miles per hour, which differs but little from the average velocity of storms in other parts of the United States. The lowest latitude attained by any of these storms was 22½ degrees; and in only three cases did the low-centre reach the parallel of 25 degrees. In eight cases the storm centre, after completing its course towards the southeast, changed its course and preceded towards the north or northeast. In two of the remaining cases the intensity of the storm declined in advancing southward, and they apparently became extinct soon after the dates given in the table. The same was probably true in the six remaining cases, but the observations are not sufficient to establish this with certainty.

Storm No. 12 was quite peculiar, having pursued a path almost directly opposite to that of ordinary storms. During the afternoon of Aug. 20th, 1878, there was an area of low pressure (29.75) over West Virginia, being part of a greater depression whose centre was over Newfoundland, and there was a slight tendency to the formation of an independent system of circulating winds. Owing to a slight increase of pressure on the north side, this low area was crowded south-