modify or intensify approaching cold waves. The probable intensity of a cold wave must be calculated for the varying conditions peculiar to each of the districts, and in many instances for conditions peculiar to localities. Unlike warm waves, which often produce in the central and northern districts temperatures higher than those noted in more southern latitudes to the windward, cold waves are not attended in the central and southern districts by temperatures lower than those noted to the north and west. On the contrary, the cold waves diminish in intensity as they sweep south and east, so far as the degree of actual cold is concerned, although the temperature may be relatively lower with reference to the normal temperature. As cold waves approach the moist regions of the Great Lakes and the Gulf and Atlantic coasts, conditions must be very marked to insure their overspreading those districts. For, as cold waves follow general storms, and as areas of precipitation, and even of cloudiness, are generally fatal to the advance of a cold wave, the forecaster should be very certain that the weather will clear up in a district before ordering cold-wave signals for that district.

Herein lies the difficulty of verifying cold-wave signals in the coast and Gulf regions; for the weather is often slow to clear up in the Gulf and Atlantic coast States, and in addition, there sometimes appears to be a slight fœhn effect produced in districts to the leeward of the Appalachian range of mountains; this, however, has not been proven. In the Southern States cold waves can rarely be successfully forecasted unless a well-defined low area crosses that region, followed by a well-marked and unbroken high area which has occasioned a decided cold wave in districts to the west or northwest. Twenty-four to thirty-six hours are usually required for a cold wave to advance from Texas to the south Atlantic coast. In January the cold waves of the central and northern districts attend the passage of the general type of storms that pass eastward from the north Pacific coast and the Saskatchewan Valley. As these cold waves drop down from the British Northwest Territory in the rear of and immediately follow the storms of this type, they assume corresponding velocities. The average time for a cold wave to advance from the British Northwest Territory to the middle Atlantic and New England States would, therefore, be sixty to seventy-two hours. But as the storms vary in velocity, so would the time required for a cold wave to sweep the northern regions vary. In all cases the velocity of cold waves must be governed by the velocity of the low areas and of the succeeding high areas, and their intensity upon the observed temperature distribution, and the intensity of the low and high areas which promote, sustain, and propel them.

NOTES BY THE EDITOR.

LOCAL CONTRAST OF WEATHER AT LONG BRANCH.

Mr. W. D. Martin, displayman U. S. Weather Bureau, Long Branch, N. J., reports that—

On January 29, in the morning, along the beach at that place the temperature was high and spring-like, but that two blocks back from the beach, namely, about 500 feet, it was cold and raw, and also snowing, with a light northeast wind, and that he had never experienced any phenomenon like this during sixteen years' residence on the coast. The reverse phenomenon is quite common, viz, in the summer time there occurs cold and raw weather along the beach with a west and northwest wind, while it is very hot at a little distance back. The latter phenomenon seems easily explained but the former not.

The inland temperatures at 8 a. m. and 8 p. m. were: Philadelphia, 18 and 24; New York, 18 and 24; Atlantic City, 22 and 24. Apparently the northeast wind had blown relatively warm surface water on to the New Jersey shore so that the local sea breeze was warm and moist, but as it penetrated inward and rose it mixed with the cold land air and the moisture was precipitated as snow.

THE ICE CROP FROM A METEOROLOGICAL POINT OF VIEW.

The observer at Clinton, Iowa, states in his January report that the cleanest and most transparent ice ever harvested was gathered during this month. Mr. J. Warren Smith, editor of the Bulletin of the New England Weather Service, states that observations show that the coldest places in New England are in the deep narrow valleys in the mountain regions, so we naturally expect the ice to form thicker on ponds in valleys during a cold spell.

Mr. W. R. Perry, of New London, Conn., inquires: "Have you any information that will enable me to choose the best location for an ice pond on the line of the New London Northern Railroad? Notwithstanding the general fact that the valleys are colder than higher ground in the same vicinity, my experience is that the higher up the pond is located the thicker the ice. Thus, at Belchertown, Mass., in 1890, the ice measured several inches thicker at the pond on the hill than at another pond in the valley a mile to the northward. At Winchester, N. H., the ice on Forest Lake was always thinner than in the pond on top of the mountain near by." He has noticed that a pond exposed to the wind at low temperatures froze rapidly after the wind went down, and usually overtook a less exposed pond that had several inches the start. He thinks that water kept in motion while cooling, so as to prevent freezing on the surface, produces anchor ice. "The best quality of ice comes from either of two reasons, sufficient depth of pond, say 30 feet, or a sufficiently rapid current to remove the air which gives it a white, transparent look." The inquiry thus started by the New England Weather Service has a very considerable practical value and theoretical interest. On the one hand observers near water ponds and streams, and the keepers of reservoirs, can contribute much to our knowledge of this subject by keeping a daily record of the temperature of the water at the surface, and also at several depths, in both the shallow and deep portions of the ponds. The records should be kept up throughout the year and studied with regard to the influence of winds and clear sky. On the other hand a theoretical study into the mode of action of whatever may influence the temperature is necessary in order to properly utilize such observations in explaining the past or predicting the future quality of the ice or in locating the best ice ponds.

A SILENT ELECTRICAL AND DUST STORM IN OKLAHOMA.

Dr. J. C. Neal, director of the Oklahoma Agricultural and Mechanical College, reports as follows:

During the morning of January 20 the sky was filled with cirrus clouds, very feathery and white. In the afternoon it became hazy, then dark, and looked like rain. Wind in puffs from the southwest. At nightfall the sky cleared, but somewhat hazy. At 8 p. m., seventy-fifth meridian time, the wind changed to the west, and a gale began; by 9 p. m. it was frightful. The dust passed along in columns fully 1,000 feet high, the wind arose to a speed of 35, then 45 miles per hour, with gusts reaching 55 miles, the temperature fell rapidly, and we saw for the first time (about 9 p. m.) flashes of light that apparently started from no particular place, but pervaded the dust everywhere. As long as the wind blew, till about 2 a. m., January 21, this free lightning was everywhere but there was no noise whatever. It was a silent electrical storm. This morning the sky is clear and except that the dirt is piled up over books, windows, and in all the house, no one would know what a fierce raging of wind and sky we had.

OBSERVATIONS AT HONOLULU, HAWAIIAN ISLANDS.

As the weather on our Pacific coast depends so largely upon the conditions of the atmosphere to the westward, it is considered important to publish in full and as soon as practicable the data furnished by observers in Alaska, the Hawaiian Islands, and adjacent regions.

Meteorological observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, Meteorologist to the Government Survey.

Pressure is corrected for temperature and reduced to sea level, but the gravity correction, —0.06, is still to be applied.

The absolute humidity is expressed in grains of water, per cubic foot, and is the average of four observations daily.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 10.

The rainfall for twenty-four hours is given as measured at 6 a. m. on the respective dates.

January, 1895.	Pressure at sea level.			Temperature.					Humidity.			Wind.		Cloudiness.	Rain measured at 6 a. m.
	9 a. m.	3 p. m.	9 p. m.	6 a. m.	2 p. m.	9 p. m.	Maximum.	Minimum.	Relative. 9 a. m.	Relative. 9 p. m.	Absolute.	Direction.	Force.		
	Ins.	Ins.	Ins.	°	°	°	°	°	%	%					Ins.
1 ..	30.15	30.07	30.12	62	77	67	78	61	74	80	6.2	se-sw.	2	8	.00
2 ..	30.03	29.93	29.96	62	73	65	77	61	70	87	6.2	nw-s.	2	3-8	.00
3 ..	29.92	29.82	29.91	66	74	71	75	64	79	85	6.9	s.	3	10-4	.04
4 ..	29.96	29.91	30.02	71	74	73	78	70	77	92	7.5	sw.	2	10-8	.00
5 ..	30.04	29.93	30.01	67	75	68	76	66	90	90	7.0	s.	0	10	.26
6 ..	30.02	29.90	29.97	62	71	64	76	62	90	85	5.9	nw-sw.	1	10-0	1.46
7 ..	30.00	29.93	30.01	58	74	61	75	58	64	85	5.0	s.	0	0	.00
8 ..	30.04	29.96	30.04	62	74	68	77	59	79	90	6.8	s.	1	4	.00
9 ..	30.06	29.96	30.01	67	77	69	79	67	79	95	7.0	s.	2	3	.00
10 ..	30.00	29.89	29.96	67	75	69	79	67	78	85	7.5	sw.	1	2	.08
11 ..	29.97	29.89	29.94	71	76	71	79	69	80	79	7.4	sw.	3	6	.00
12 ..	29.95	29.90	29.98	72	75	71	76	69	80	88	7.5	sw.	3	9	.00
13 ..	30.04	29.97	30.06	71	76	71	78	70	83	88	7.7	sw.	1	8	.06
14 ..	30.04	29.98	30.05	71	75	73	76	70	77	73	6.9	ne.	2	10	.05
15 ..	30.05	29.94	30.04	72	76	73	76	72	74	74	6.5	ne.	4	8	.00
16 ..	30.07	29.98	30.06	72	74	72	76	72	70	76	6.2	ne.	4	10	.00
17 ..	30.06	29.99	30.06	70	74	72	75	70	77	80	6.9	se.	0	10	.00
18 ..	30.09	30.01	30.06	69	75	72	77	68	75	75	6.7	se-e.	3	5	.03
19 ..	30.12	29.99	30.07	71	73	70	75	70	77	80	6.2	e-ne.	4	7	.01
20 ..	30.08	30.04	30.06	70	74	71	76	68	70	70	6.0	ne.	4	8	.09
21 ..	30.02	29.95	30.01	69	76	70	77	69	66	70	5.8	ne.	3	3	.01
22 ..	29.99	29.88	29.96	60	74	69	76	60	68	74	5.7	nnw-nne	3	3	.01
23 ..	29.95	29.89	29.96	59	76	63	77	59	74	85	5.5	se.	2	3	.00
24 ..	29.92	29.85	29.90	60	75	70	76	59	73	73	6.0	s.	2	2	.00
25 ..	29.95	29.93	30.03	68	70	65	73	65	75	50	4.7	nw.	2-5	10-0	.13
26 ..	30.08	29.98	30.02	62	70	63	72	61	58	56	4.1	n.	3	3	.00
27 ..	30.02	29.93	29.94	54	73	57	74	53	59	82	4.6	n-sw.	1	2	.00
28 ..	29.92	29.83	29.92	55	74	70	75	55	71	72	5.0	s.	2	8	.00
29 ..	29.88	29.84	29.92	66	73	66	77	63	66	90	6.1	sw.	3	8	.00
30 ..	29.94	29.86	29.92	64	72	67	74	61	85	92	6.4	sw.	3	8	.17
31 ..	29.90	29.83	29.89	64	74	68	75	63	85	90	6.9	sw.	3	3-8	.39
	30.01	29.93	29.99	65.6	74.2	68.5	76.1	64.5	74.9	80.4	6.3	....	......	......	2.79

Pressure, 29.968, or 0.04 below normal.
Temperature, 69.4, or 0.4 below normal.
Relative humidity, 5 per cent above normal.
Rainfall, 70 per cent of the normal.
Heavy swell of the sea from the north on the 17th.
Northerly gale, cold wave, very low humidity, 26th to 28th.
General earthquake through the group, *not* from Kilauea, 10 p. m., 22d.

OPTICAL PHENOMENA.

Dr. Luke Roberts, at Clinton, Iowa, reports the following interesting optical phenomenon:

A solar halo of unusual interest prevailed all the afternoon of the 15th. Above the sun and near the zenith appeared a segment of a parhelic circle, with its convexity toward the sun. This prismatic beauty, which lasted over an hour, occupied about one-fourth of a complete circle, and formed a line of demarcation of clear sky from its concavity northward and of light clouds to the southward of its convexity. Parhelia, or mock suns, formed to the right and to the left of the sun, becoming more interesting toward the close of the day by their enlarged appearance and prismatic colorings. On the 30th a rare phenomenon was seen, being luminous beams reaching upward and also downward from the moon just previous to its setting.

The 31st furnished the most gorgeous sunset ever witnessed here. In addition to the intense glow which spread out in dazzling splendor, a broad colored band, resting on the sun, reached upward several degrees. All this beauty soon faded and the day and the month ended.

At Mount Sterling, Ky., January 13, 10 p. m., the voluntary observer, Mr. James O'Connell, observed a vertical column of light above and below the moon in a clear sky; it extended above the moon about one-quarter of the altitude of the moon above the horizon; the lower half of the column below the moon widened out at the middle point, and was about four times as broad at the horizon as it was in its upper portion. In answer to a request for an explanation of this phenomenon the editor would remark that almost every form of halo and optical phenomena has been explained by Bravais in his work on halos, Paris, 1847; other forms of phenomena, especially the polarization of skylight, has been explained more recently by Bosanquet and Rayleigh. A summary of our present knowledge of the subject is given by Mascart in his "Optics."

The general explanation of the vertical columns, as observed at Mount Sterling, is as follows: The clear sky contained innumerable minute crystals of ice, such as when aggregated together form the feathery flakes of snow and the beautiful frostwork. These crystals are, when examined microscopically, usually seen to be six-sided prisms, whose ends are formed of six facets symmetrically arranged around a central facet that is perpendicular to the axis of the crystal. Sometimes the ends are simply broad hexagonal plates, so that the prism, with its two end plates, looks like a long and delicate spool. Sometimes only one plate is present, at other times the prism is absent and the plates alone are present. In fact, whatever varied form the crystals and snowflakes assume they may be considered as built up of thin six-sided plates. All the phenomena of halos, parhelia, and columns of ice are the result of the reflection and refraction of sunlight, or moonlight, by these crystals. When the air is quiet and the minute crystals are settling very slowly downward to the earth there will always be found a large number that are in very similar positions. Thus, if the sky is full of long prisms, each of which has a small plate at one end, these will have their long axes nearly vertical; the plates will be above and act as parachutes to delay the fall of the prisms, consequently the plates will be nearly horizontal, or possibly, vibrating for a few degrees either side of horizontality. If the prism is short and the plate broad then the oscillations will be larger than for long prisms.

PARHELION, JANUARY 27, 1895.

Mr. Axel F. Elfstrum, voluntary observer at Willmar, Minn., communicates a description of a very fine parhelion observed on Sunday, January 27, between 9–10.30 a. m. As the drawing sent by the observer can not be easily reproduced the following description will suffice to enable the reader to reconstruct it. Imagine the sun at an altitude of 15° to 25°, and a horizontal circle (*P*) passing through it; the principal mock suns lay in this circle, which was itself a clear bright band as broad as the diameter of the sun and stretching all around the heavens and having therefore the zenith as its center.

This circle is usually called the "parhelic" circle. Two other arcs were also visible between the sun and the zenith. The larger of these (*L*) had the zenith for its center with a radius of 45° or 50°; the smaller one (*S*) also had the zenith for its center and a radius of 20° or 30°. The arcs (*L*) and (*S*) differed from (*P*), in that they did not entirely surround the heavens, and especially in that they were brilliant rainbows, whereas *P* was bright but colorless. Two other bright bands were also seen; these were also circles and were colorless and very bright; these surrounded the sun as a center. The smaller one (*C*) appears to have had a radius of about 20°, and the larger one (*CC*) had a radius twice as great, or 40° to 45°. The rainbow circle (*L*), was tangent to the upper edge of the bright circle (*C*) and the rainbow circle (*S*) was tangent to the bright circle (*CC*). At the two points where the bright circle (*CC*) intersected the parhelic circle (*P*), there appeared two "mock suns" so sharp and bright that it was almost impossible to look at them with the naked eye. When the sun was southeast of the observer these two "mock suns" were respectively a little north of east and a little east of south. Farther along on the parhelic circle there were seen two other "mock suns" almost equally bright. These were respectively at the west-southwest and north-northeast points of the compass, or 112° west and 112° east of the sun. The sky was clear but the air filled with light frost; the wind was northwest, and the thermometer read —24° F.

The general explanation of the formation of halos and parhelia was first elaborated by Bravais and published in

1847 in the Journal of the Polytechnic School at Paris. These phenomena depend entirely on the refraction and reflection of sunlight from the ice crystals that make up the snowflakes. The elementary crystal is a regular hexagonal plate; prisms that are so long as to be called needles may be made up of such plates laid on top of each other, in which case the hexagonal prism sometimes has a flat end, sometimes it is a hexagonal pyramid, and more often it is a truncated, namely, an incomplete, pyramid. When the sky is clear and the temperature very low the air seems to be transparent or hazy, although it is filled with a great number of these prisms, sufficient to give us reflected "mock suns," while at the same time the sun itself is perfectly visible. When the air is still the plates and prisms and simpler forms of snowflakes descend so slowly that myriads of them get into a vertical or horizontal, or some other stable position as they slowly settle down to the earth. According to the experiments and observations of Bravais the smaller bright circle (C) should have a radius of about 22° and the larger circle (CC) a diameter between 43° and 50°, depending on the altitude of the sun. The larger rainbow circle (L) and the smaller rainbow circle (S) depend upon the dispersion of the rays of light that pass through prisms which are nearly vertical, as they settle down through the atmosphere; the ray of light enters the upper and leaves the lower end of the prism. The small rainbow circle (S) approaches to within 21° 50′ of the sun, and therefore appears to be tangent to the large bright circle (CC). It is, however, not an exact circle, but only approximately so. The large rainbow circle (L) is also only an approximate circle, and at its nearest approach to the sun it is distant from it by an angle of from 20° to 25°, depending on the altitude of the sun. It is therefore apparently tangent to the small bright circle (C).

Observers who have an opportunity to make exact angular measurements by means of a sextant would contribute much to the explanation of parhelic phenomena if they would measure the altitude and azimuth of the sun and the "mock suns," the ends of the arcs or rainbows, and the widths and diameters of the circles.

SNOW DUST.

On the night of January 11–12 and along the advancing edge of a cold wave there fell throughout a large part of Indiana and Kentucky a shower of dust in connection with snow. It does not appear that this dust was the nucleus of snowflakes, but that it was intermingled in the air with the snow or fell with the wind that preceded the second snowfall. Considerable interest having been excited and numerous inquiries having been addressed to the Weather Bureau, it was decided to send circulars of inquiry to voluntary observers and others, with a view to obtaining samples of the dust and some idea of its geographical distribution. A few replies indicate that no dust was seen in their neighborhood. Other observers were so fortunate as to obtain samples, which were forwarded to the Weather Bureau for examination and referred to the experts of the Department of Agriculture. A few local experts also made independent examinations and communicated their results to the Weather Bureau.

The following is a summary of our knowledge of this subject:

Persons reporting that no dust fell.

N. I. Kithcart, Columbia City, Whitley Co., Ind. The observer says that Fort Wayne, 20 miles east of this city, is the nearest place at which dust is reported.
W. H. Guthrie, Gas City, Grant Co., Ind.
Postmaster, Portland, Jay Co., Ind.
John M. Lockwood, Mount Vernon, Posey Co., Ind.
Charles G. Boerner, Vevay, Switzerland Co., Ind.
C. B. Magers, Churubusco, Whitley Co., Ind.
Rev. E. J. Spelman, Cambridge City, Wayne Co., Ind.
H. H. Swain, South Bend, St. Joseph Co., Ind.
M. A. Spake, Bluffton, Wells Co., Ind.
J. N. Roe, principal of normal school, Valparaiso, Porter Co., Inda.
Elisha Jones, Princeton, Gibson Co., Ind. No snow on the 12th, little snow on the 13th, but no snow dust in Gibson County.
Stevens & Durham, Muncie, Delaware Co., Ind.
Prof. Malverd A. Howe, Terre Haute, Vigo Co., Ind.
Walsman Bros., Batesville, Ripley Co., Ind. No dust fell here, but did fall in southern part of Ripley County.

Persons reporting dustfalls in connection with the snow, but not sending samples.

Walton & Whistler, Atlanta, Hamilton Co., Ind.
Tipton Lumber Company, Tipton, Tipton Co., Ind.
William McGrew, Huntington, Huntington Co., Ind., and 10 miles north thereof.
Prof. H. A. Huston and W. J. Jones, jr., Purdue University, Lafayette, Tippecanoe Co., Ind.
G. A. Stanton, Greenwood, Johnson Co., Ind.
Postmaster, Albany, Delaware Co., Ind.
T. E. Huston, Cannelton, Perry Co., Ind.
W. E. Horn, Cloverdale, Putnam Co., Ind.
John Johnson, jr., Bedford, Lawrence Co., Ind.
Frank H. Park, Scottsburg, Scott Co., Ind.
—— ——, Upland, Grant Co., Ind.
William H. Smith, Cutler, Carroll Co., Ind.
A. S. Chapman, Madison, Jefferson Co., Ind.
M. H. Thomas, Galveston, Cass Co., Ind.
Postmaster, Bridgeport, Clark Co., Ind.
S. T. Mc——, Vincennes, Knox Co., Ind.
W. J. Davison, Farmland, Randolph Co., Ind.
J. Swindell & Bro., Plymouth, Marshall Co., Ind.
James P. White, Degonia Springs, Warwick Co., Ind.
H. T. Simons & Co., Bloomington, Munroe Co., Ind.
H. Shireman, Martinsville, Morgan Co., Ind.
Bolivar Robbe, North Lebanon, Boone Co., Ind.
J. R. Sample, Princeton, Gibson Co., Ind.
Jonathan Beard, Star Fruit Farm, Edwardsville, Floyd Co., Ind.
C. R. Hincle, Sullivan, Sullivan Co., Ind.
C. W. Whitney, Hammon, Lake Co., Ind.
John T. Hoover, Wabash, Wabash Co., Ind.
C. F. Hale, Butlerville, Jennings Co., Ind.
John Wilkinson, Middletown, Madison Co., Ind.
G. W. Mayfield, Bruceville, Knox Co., Ind.
J. T. Whitlock, Rising Sun, Ohio Co., Ind.
W. N. Wirt, Rockville, Park Co., Ind.
H. S. Renick, Greencastle, Putnam Co., Ind.
O. S. Martin, Russiaville, Howard Co., Ind.
E. T. Neidhamer & Bros., Hobbs, Hamilton Co., Ind.
B. T. Michels, Albion, Edwards Co., Ind.
E. Wesseler, Rockport, Warwick Co., Ind.
C. Ingemann, Noblesville, Hamilton Co., Ind.
G. N. Moyer, Laketon, Wabash Co., Ind.
G. Stealy, Angola, Steuben Co., Ind.
David W. Shields, Rensselaer, Jasper Co., Ind.
Gus. Gramelspacher, Jasper, Du Bois Co., Ind.
Chas. R. Kluger, Huntingburg, Du Bois Co., Ind.
Geo. E. Walton, Clinton, Vermilion Co., Ind.
N. I. Kithcart, of Columbia City, Ind., reports dustfall at Fort Wayne, Allen Co., Ind.
H. L. Bruner, of Irvington, Ind., reports dustfalls at other places, viz, Crown Point, Lake Co., Ind.; Elnora, Daviess Co., Ind.; Spencer, Owen Co., Ind., and Elva, Marshall Co., Ky.

Localities reporting dustfalls to the Louisville Courier Journal:

Burkesville, Cumberland Co., Ky.
Slaughtersville, Webster Co., Ky.
Narrows, Clay Co., Ky.
Iron Hill, Crittendon Co., Ky.

The following is from the Illinois State Weather Service, "Weather and Crops," March, 1895:

On the morning of January 11, observers in the southern counties of Illinois found the snow covered with a dark dust that was apparently foreign to that part of the country; this dust was examined by B. T. Maher, of Albion, Edwards County, and T. J. Trevillion, Golconda, Pope County.

Persons reporting the character of the dust, as resulting from examinations made by themselves.

English (formerly French Lick), Orange Co., Ind.
Brownstown, Jackson Co., Ind.
Spencer, Owen Co., Ind.
Covington, Fountain Co., Ind.
English, Crawford Co., Ind. (newspaper clipping).
Chemical Laboratory, High School, Indianapolis, Marion Co., Ind.
Butler University, Indianapolis, Ind.
Bruceville, Knox Co., Ind., G. W. Mayfield, M. D.

Persons sending samples to the Weather Bureau for examination.

Dr. J. N. Harroty, Indianapolis, Marion Co., Ind.
Robert Hessler, Logansport, Cass Co., Ind.
Dalton Wilson, Greenwood, Johnson Co., Ind.
Calvin Fletcher, Spencer, Owen Co., Ind. (2 samples.)
A. N. Johnson, New Ross, Boone Co., Ind.
F. Thrasher, Smithville, Monroe Co., Ind.
W. H. Stanton, Pendleton, Anderson Co., Ind.
Prof. Drybread, Anderson High School, Anderson, Madison Co., Ind.
W. Crane, Covington, Fountain Co., Ind.
W. P. Gosnell, and Fred. Friedersdorff, Madison, Jefferson Co., Ind.
John Kennedy, Vincennes, Knox Co., Ind.
George Tindale, through S. B. Morris & Co., Shelbyville, Shelby Co., Ind.
D. H. Hostetter, through J. F. Warfel, Ladoga, Montgomery Co., Ind.
G. H. Morgel, Brazil, Clay Co., Ind.
J. Oouthout, Surprise, Jackson Co., Ind.
J. E. Young, Topeka, Lagrange Co., Ind.
Butterworth & Co., Marion, Grant Co., Ind. (2 samples possibly from different localities.)
W. B. Squire, Worthington Greene Co., Ind.
Z. Warren, Carmel, Hamilton Co., Ind.
A. Hugh Bryan, Lafayette, Tippecanoe Co., Ind.
A. Hugh Bryan, Indianapolis, Marion Co., Ind.
D. N. Berg, Indianapolis, Marion Co., Ind.
Mr. Perry Philipps, Pigeon, Spencer Co., Ind.
William Hart, Quincy, Owen Co., Ind.
—— ——, Pimento, Vigo Co., Ind.
Lafe Crosier, Laconia, Harrison Co., Ind.
J. B. Pence, Crawfordsville, Montgomery Co., Ind.
Mrs. Belle B. Peyton, Crawfordsville, Montgomery Co., Ind.
Jas. O. Parker, Danville, Hendricks Co., Ind.
H. P. Heller, Brownston, Jackson Co., Ind.
David Grable, Corydon, Harrison Co., Ind.
N. Wilson, through R. H. and J. N. Dean, Iron Hill, Crittenden Co., Ky.
H. L. Bruner, Irvington, Marion Co., Ind.
Shirk and Miller, Peru, Miami Co., Ind.
Joseph Miller, Iris, Harrison Co., Ind.
Oscar Brent, English, Crawford Co., Ind.
John Wilkinson, Middletown, Henry Co., Ind.
George B. Jordan, Morristown, Shelby Co., Ind.
Dr. T. C. Hunter, Kokomo, Howard Co., Ind.
The "Evening-Tribune," Greenfield, Hancock Co., Ind.
W. F. Taylor, Thorntown, Boone Co., Ind. (It is probable that this was collected on March 25th, and this address is therefore properly transferred to the subsequent list under section H.)

The reports of Messrs. Galloway and Woods on the character of the samples sent to the Weather Bureau.

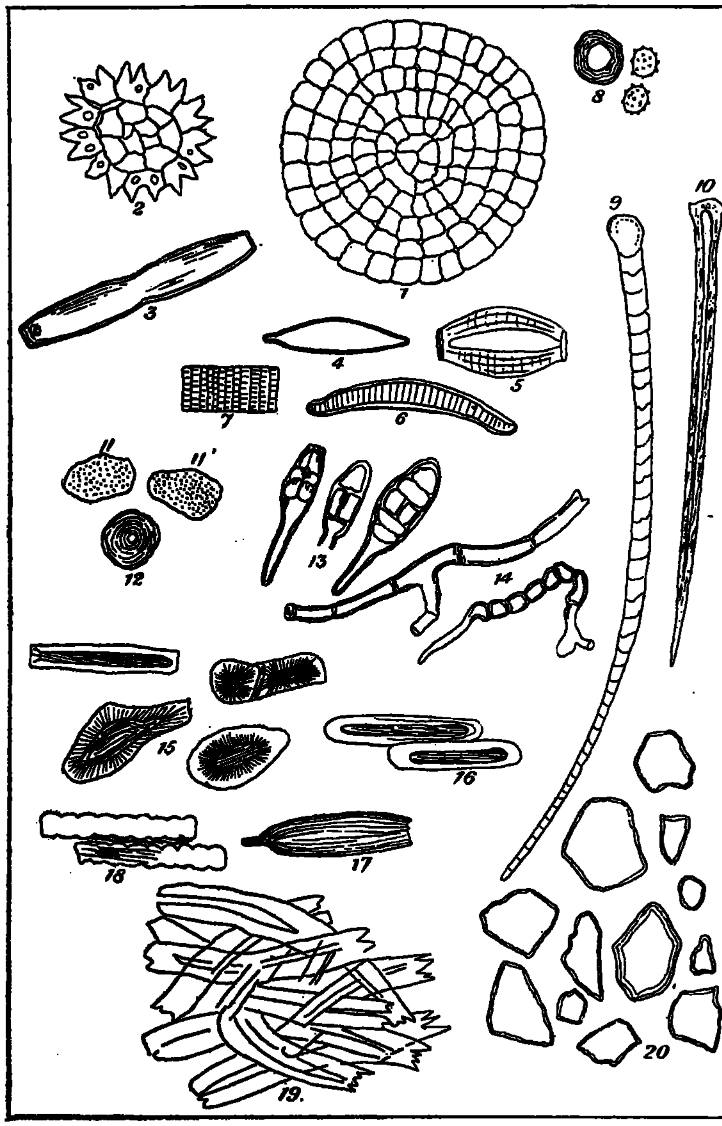
The samples in the above-mentioned list were sent to the Division of Vegetable Pathology with the request that they be subjected to a microscopic, and, if necessary, a chemical examination. The reports of Messrs. Galloway and Woods, as sent in from time to time, may be summarized as follows:

DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PATHOLOGY, *January* 31, 1895.

I have submitted to my assistant, Mr. Woods, the sample of soil supposed to have fallen in Indiana, between two snowstorms, January 11, 1895, and he furnishes the following report:

"The soil is made up largely of silt, mixed with organic matter. A number of fresh-water algæ could be distinguished, though they had evidently been dead and dried for a long time. Two of these, viz, Coleochæte, and a Desmid, possibly *Closterium*, indicate that the source of the 'dirt' was the bottom of some shallow lake, pond, or marsh that had dried up. These two algæ usually grow in water that is comparatively fresh, and which seldom dries up completely. Another algæ, viz, *Pediastrum*, and an animal plant, *Euglena veridis*, show that for some time the water had been stagnant. The Diatoms are found wherever there is water. A fungus belonging to the genus *Macrosporium* was also found. This occurs very commonly on dead plant tissue. The epidermal cells of decayed grasses and sclerotic cells from the decayed fruits of grasses occur in the débris. Animal and plant hairs are common, also bast fibers of grasses, shreds of woody tissue of some shrub or tree, etc. Masses of mixed and interlaced fibers looking like paper are occasionally seen. Everything indicates that the 'dirt' came from the bottom of some dried-up lake, pond, or marsh, or some river bottom. It would be well to look for some such place as this on the windward side near where this material was gathered. It is, however, light enough to be carried some distance by a strong wind. The plants found have wide distribution and are common all over Indiana, and in fact all over the whole of North America, at least."

The accompanying drawings show some of the material present in the dirt. Fully 96 per cent of it is silt, and 4 per cent organic matter.



1. Coleochæte orbicularis.
2. Pediastrum sp.
3. Desmid.
4, 5, 6, 7. Group of diatoms.
8. Pollen grains.
9. Animal hair.
10. Plant hair.
11. Euglena viridis.
12. A little fresh water animal.
13. Macrosporium spores.
14. Mycelium of Macrosporium.
15. Group of sclerotic cells.
16, 18. Epidermal cells of grass.
17. Butterfly scale.
19. Piece of paper.
20. Soil, silt.

February 4, 1895.—The second sample of dust is somewhat richer in organic matter, but is of exactly the same nature as the first.

February 23, 1895.—The additional samples of snow dust have been examined by my assistant, Mr. Woods, who reports as follows:

"The samples from Crawfordsville, Greenfield, Morristown, Covington, Vincennes, Indianapolis, Smithville, Logansport, Greenwood, Spencer, in Owen County, New Ross, Indianapolis and Lafayette, all in Indiana, also from Stattler, Ark.—dustfall of February 7—are all fine silt, containing organic matter almost exactly as described for the sample first sent to us. They all indicate a locality such as therein described. The remarks made on this first sample apply in every particular to those named in the preceding list. These samples contain no soot from chimneys or gas wells or ash from the northwest forest fires. The dark color is due to the presence of a coating of dissolved organic matter on the particles of silica and the presence of decaying organic matter mixed with the silica. The dust may have come from the northwest from some dried-up marsh, lake, or pond. There is nothing in the material to give any definite indication of the region from which it came. The same material might be found in dried-up lakes, ponds, marshes, etc., almost anywhere on this continent."

"All the samples indicate that the dust was lifted by some windstorm, spread out in an upper-air stratum, and precipitated. The samples from Kokomo, Madison, Anderson, and Pendleton had a large mixture of local material too heavy to be carried far by the wind."

"February 28, 1895.—The specimens from Ladoga, Surprise, Lacrosse, and Irvington, Ind., are the same as the material first reported on. The samples from Topeka, Marion, and Carmel contain considerable material of local origin, such as white-lead paint, colored glass, ash, and sand; the specimen from Marion contains more organic matter than the other samples, but is of a similar nature."

"March 5, 1895.—The sample of snowdust from Peru, Ind., is of the same material as most of the other samples; it is somewhat richer in organic matter and the silt appears to be finer than most of the other samples."

"March 15, 1895.—The samples from Brownston, Corydon Co., Ind.; Iron Hill, Crittenden County, Ky.; Silver Springs, Benton County, Ark. (snowfall of February 7), are all of the same material as those previously examined. The mud formed by these samples is no more greasy or pasty than that formed by the others previously examined. The greasy feeling is due to the fineness of the particles and not to the presence of grease. These samples have about the same fertilizing value as ordinary silt containing organic matter."

"April 8, 1895.—The samples from Thorntown, Middletown, and English, Ind., are the same as those previously examined, viz, very fine silt, with organic matter of pond or marsh origin. The sample from Carmel, Ind., is made up of fine sand and shreds of decaying wood. Judging from the size of the particles, they have evidently not been carried far by the wind."

In addition to the microscopic examination Prof. Milton Whitney was requested to make a physical examination of this dust considered as an additional element in the soil, and this was particularly desired in virtue of the fact that the idea had been widely disseminated throughout the West that this fine material was especially valuable as a fertilizer.

The reports submitted by Professor Whitney, from time to time, may be summarized as follows:

February 1, 1895.—A very small sample of a black earth which is said to have been deposited upon the snow near Rockville, Ind., in such an amount and under such conditions as to be popularly known as black snow has been handed me for mechanical analysis, and I undertook the work with considerable interest. The sample delivered to me weighed but a fraction over half a gram, while we usually take at least 20 grams for a mechanical analysis. It is, therefore, quite possible that in a larger sample measurable quantities of sand might have been found, but there would have been nothing coarser than our grade of "very fine sand," with diameters ranging from 0.10 to 0.05 millimeters (0.0039 to 0.0020 inches). The mechanical analysis shows this dust material to be almost identical with the loess formation that covers very extensive areas in Illinois, Indiana, Nebraska, and other adjoining States. As a matter of interest, I send you the mechanical analysis of an "upland" loess near Virginia City, Cass Co., Ill., which is almost identical in composition with the sample from Rockville, Ind. This loess from Virginia City is in all probability a wind deposit. I send you also the mechanical analysis of a river loess from the same locality. This is quite similar to the upland loess, except that it has a larger proportion of very small sand and a smaller proportion of clay. These are typical of a large number of samples that we have examined from the State of Illinois. I send you also the mechanical analysis of the loess formation of Nebraska, notable again for its large content of silt and being almost identical in composition with the river loess from Virginia City. There is a long standing controversy as to the origin of the loess formation of the Northwest. Certain portions of the loess formation of Asia are known to be wind deposits. There is very strong presumptive evidence that much of the loess of our western States is a wind deposit. This sample from Rockville is very interesting as bearing upon this point, for there is no question but that this slight deposit has been carried by the wind.

You ask in your letter for some suggestions as to the velocity of the wind "required to keep the heavier particles up in the air for any length of time." I estimate in my work that a single particle of silt, of average size, weighs 0.000037 milligram, and that it has a surface area of 0.00283 square millimeter, and the particles may be assumed to be spherical in shape.

February 6, 1895.—I have examined the sample from Crawfordsville, Ind., sent in your letter of February 4, and believe it to be substantially the same as the sample previously examined. This larger sample may possibly contain more of the grade called "very fine sand," but the proportion of this, if any exists, is evidently very small and unimportant. The analysis previously sent you is quite reliable and identifies the material with the loess, whose origin, as I have stated in my last letter, is believed by many to be due to the wind.

March 5, 1895.—I have examined the twenty-seven samples of snow dust, mostly obtained from portions of Indiana, and believe them to be almost identical in texture to the first sample you sent, of which I made a mechanical analysis. I feel sure that these samples represent the dust which has been suspended in the air and blown from place to place, and that they have the same texture as the typical loess soils of the West, containing a large percentage (from 50 to 70 per cent) of silt, with comparatively little clay and practically no sand. It is just such material as would be expected in any moderate duststorm, and could have been carried very considerable distances.

April 15, 1895.—I have carefully examined the thirty-five additional samples of snow dust recently sent to me, and will make mechanical analyses of them at any time when it seems advisable to do so.

April 19, 1895.—The samples from Thorntown, Middletown, and English, Ind., are the same as those previously examined. The sample from Carmel, Ind., is quite different from any other examined, it is composed of heavy sand with many fibres of wood, and apparently came from some place not far away.

MECHANICAL ANALYSIS.

Percentage by weight of the contents of an air-dried sample.

Sample No.	Locality.	Moisture.	Organic matter.	Gravel, 2.0–1.0 mm.	Coarse sand, 1.0–0.5 mm.	Medium sand, 0.50–0.25 mm.	Fine sand, 0.25–0.10 mm.	Very fine sand, 0.10–0.05 mm.	Silt, 0.05–0.01 mm.	Fine silt, 0.010–0.005 mm.	Clay, 0.005–0.0001 mm.
2047	Rockville, Ind., black snow	3.17	11.98	0.00	0.00	0.00	0.00	0.00	69.37	5.80	9.68
1317	Virginia City, Ill., upland loess	......	......	0.00	0.00	0.00	0.01	7.68	61.85	9.60	15.15
1316	Virginia City, Ill., river loess......	......	......	0.00	0.00	0.01	0.10	24.84	60.98	2.80	6.15
1717	Nebraska loess formation	5.40	4.96	0.00	0.00	0.00	0.00	28.14	54.81	2.46	9.45

In addition to the preceding analyses as made by the Department of Agriculture, the following remarks have been received from various observers and specialists:

Mr. Calvin Fletcher, of Spencer, Owen Co., Ind., reports that the dust was examined by local physicians and pronounced unfit to pass into the cisterns of drinking water because of the rod-shaped bacilli. (It is difficult to believe that such bacilli had anything to do with the snow dust proper.)

W. Crane, of Covington, Ind., states that his samples burn white under the blowpipe. (Evidently the heat of the blowpipe dissipates all moisture and organic matter, leaving only sand and clay, which would agglomerate into white grains.)

Dr. G. W. Mayfield, of Bruceville, Ind., states that he finds the snow dust to be a mineral dust, finely powdered, containing but little grit and of a strong metallic taste, rather irritating to the mucous membrane. The microscope showed it to be neither coal nor wood ashes, charcoal, soot, nor clay.

Mr. James O. Parker, Danville, Ind., notes that on the day previous, viz, January 11, a severe duststorm, with a wind velocity of 40 miles per hour, prevailed in southeastern Iowa, where the ground was bare of snow. From 9 square feet of snow Mr. Parker obtained 49 grains of dust, or, approximately, 5.4 to the square foot, or, more exactly, 33.33 pounds avoirdupois to the acre.

Mr. H. P. Heller, of Brownston, Ind., after melting several pans of dusty snow, found that the resulting sample was a very greasy, black, pasty substance.

Mr. Carl A. Starck, of Silver Springs, Benton Co., Ark., sends a sample of dust collected after the blizzard of February 7–8, and reports that this dust is said to be a great fertilizer. (The analyses made by Messrs. Galloway, Woods, and Whitney suggest that this dust is no better fertilizer than any other surface soil.)

Prof. H. L. Bruner, of Irvington, Ind., states that in general a layer of snow about one-quarter of an inch deep was colored distinctly brown by the dust. It fell on a bed of snow several inches deep, and was thus protected from contamination by surface dust. A sample of this snow gave 0.37 per cent of dust by weight; carbonates seem to be almost wholly absent. The material was probably not derived from a limestone region. Several tests of the water obtained by melting the snow gave a uniformly neutral reaction with test paper. The weight of dust per square foot, as determined from two measurements, is about 0.3198 grams (or 30.7 pounds avoirdupois per acre), of which about two-thirds is silica. The mineral fragments often have their angles rounded as if windworn; the largest observed had a diameter of 0.05 millimeters. According to Buchanan, the mineral particles found in deep-sea deposits, far from land, having been carried out there by the wind, seldom exceed this size. Numerous diatoms and other low plants have been found, but have not been identified. Fragments of higher plants, including many fragments of silicified cell-walls, are abundant. Among foraminifera a few genera only have been recognized as yet.

Mr. John T. Campbell, of Rockville, Ind., reports that about 5 inches of snow fell on top of the dust layer and that the dusty snow when melted seemed to form a layer of about 0.02 of an inch thick of solid or compact dust. He gathered from a small circle of 5.85 square feet the quantity of 12 grains by careful weight of dust, which is at the approximate rate of 2 grains to the square foot, or, more exactly, 12.77 pounds avoirdupois to the acre. He made a second collection of dustfall over a circle of 25 inches radius, or 13.64 square feet, which gave 35 grains, or an average of 2.5 grains to the square foot, or at the rate of 12.76 pounds avoirdupois per acre.

Dr. John L. Howard, of Louisville, Ky., has examined many specimens from places in southern Kentucky and southern Indiana, and states that the foreign substances were inorganic in character, consisting mainly of finely-divided particles of silica, with traces of mold and other matters that would be likely to be blown by high winds from country roads and fields.

Prof. C. A. Colgrove, of the Normal College, Danville, Ind., calculates the total fall to have been about 5 tons to the square mile, or at the rate of 16 pounds avoirdupois per acre.

Dr. Robert Hessler, Logansport, Ind., says: "I examined some of this snow dust shortly after it fell, and found it to consist of siliceous particles, with an admixture of vegetable matter, some of which still showed chlorophyll. Scattered throughout are a number of diatoms of different kinds."

Mr. J. B. Pence, of Crawfordsville, Ind., from an area of one square yard collected about one-half ounce of dust, which is at the rate of 150 pounds per acre.

Mr. Lafe Crosier, Laconia, Harrison Co., Ind.: The earth was covered with well packed snow to the depth of about 3 inches, on top of which was 1 or 2 inches of black, sooty snow. At 6 p. m. of the 11th the wind veered from southeast to northwest, blowing a gale all night.

Jasper, Du Bois Co., Ind.: A layer of 12 inches of snow had fallen during the day, which was covered during the night of the 10th (C) by a layer of brown or dust-colored snow.

Elva, Ky.: During the night of January 11–12, 2 inches of snow fell and was found covered with a yellowish dusty tint, having the appearance of snuff, but no smell or taste. The melted snow water was inky black.

In addition to the snowfall of January 11–12, reports of similar snow dust on other dates and in other States also frequently come to hand.

January 19.—Black snow is reported by the voluntary observer at Alpha, Ky.

February 1.—At North Lebanon, Ind.

February 8.—Logansport, Ind.

February 7–8.—Mr. Carl A. Starck, of Silver Springs, Benton Co., Ark., sends a sample of dust that fell during the blizzard, and adds: "Some say that this dust is a great fertilizer."

March 25.—W. F. Taylor, Thorntown, Ind., sends a sample of dust of that date.

The weather maps for January 10–12 show that an area of strong and cold northwest winds moved rapidly southward from the British Possessions over Dakota, Minnesota, and the Mississippi Valley. The front of this cold wave covered Minnesota, Iowa, Missouri, and Kansas at 8 a. m. of January 11. At 8 p. m. this front extended from a little east of Marquette southward over Lake Michigan, eastern Indiana, and southwestward into northern Arkansas. At 8 a. m., January 12, the cold-wave front extended southward over the western portion of Lake Erie and central Ohio, eastern Kentucky, and southwestward through eastern Tennessee into northern Louisiana. The high winds that accompany the progress of the front of the cold wave were reported at velocities varying from 28 to 48 miles per hour, and their directions were always between north and west. In the absence of any definite measurements of the velocity of the air at any considerable distance above the anemometers, it is not safe to assume that the upper layers of air moved with much greater velocity than that measured near the earth's surface. The progress of the cold-wave front, as measured in the direction from northwest to southeast, amounted to about 600 miles in twenty-four hours, or 25 miles per hour. As this front was accompanied with light snow when it first appeared in Dakota and Montana and with a slightly increasing snowfall as it moved southeastward underrunning the moister air of the Mississippi Valley and the Lake region, it is not likely that the dust torn up from the surface of the ground by an especially strong wind at any spot could be borne onward to any great distance before being brought down by the snow; moreover, the strongest winds that must have carried the dust upward lasted, at the most, but a few hours, and, therefore, the dust had abundant opportunity to settle as soon as the wind died away. It is not necessary to assume that any of the dust of which samples have been sent to the Weather Bureau for examination, had been carried 100 miles by the wind. This process of raising great clouds of dust, carrying them south and east and depositing the dust finally, either by reason of its own weight or in connection with rain and snow, is a process that must have begun in Montana on the 10th to be concluded in Ohio, Kentucky, Louisiana, and Texas on the 12th and 13th.

By platting upon a chart of Indiana the stations at which dust fell and those at which none was reported, the latter are divided into three classes 1st, Valparaiso and South Bend in the northern portion of the State, and representing an area on the south shore of Lake Michigan that was protected by the Lake from distant dust; 2d, Mount Vernon, in the extreme southeastern corner of the State, but as dustfalls were reported from neighboring counties in Kentucky it is proper to classify this with the remaining third class, which, enumerating them in the order north to south, are: Columbia City, Churubusco, Bluffton, Portland, Muncie, Cambridge City, Batesville, and Vevay. These stations are on the eastern border of those that report dust, and, of course, on the eastern border of the State. They evidently represent regions within which little or no dust fell, partly because it was swerved to one side by the wind currents, but principally because the greater part of that which had been torn up by the strong winds of the daytime had already been deposited with the light winds and the snows of the nighttime over the country lying to the westward. This process by which dust is raised and carried along during the daytime and deposited, as to its finer portions during the nighttime is one that goes on continually throughout the globe. The very finest portions of the dust are generally supposed to descend only with fog, rain, or snow, thus in London, Mr. John B. Coppick has recently called attention to the quantity of solid matter brought down by snow in its fall through the atmosphere. Thus, on January 13, 1895, four inches of snow fell in the suburbs of London, the snow crystals were regular and the snow as it lay on the ground very porous; a gallon of water melted from this snow contained 10.65 grains of solid matter, 5.75 mineral, and 4.90 carbonaceous. On January 30 a similar result was obtained, and it was also found that 75 per cent. of the impurities were brought down with the first half of the snowfall. A second analysis on January 30 of snow that fell at Somerset House, nearer the center of London, gave 17.32 grains of solid matter to the gallon, of which 6.25 were mineral and 11.07 carbonaceous or sooty matter. A large quantity of ammonia was also found in this snow water, showing its great value as a fertilizer.

Professor Stokes has shown that a particle of water, such as would surround a dust particle, and convert it into a globule of fog, will descend in still air at the rate of 40 millimeters, or about 1.6 inches per second, if it has a diameter of about 0.025 mm., or about 0.001 of an inch. Hence a particle whose diameter is 0.01 mm., corresponding to Professor Whitney's finest silt, or loess, would descend at the rate of 6.4 mm., or rather more than one-quarter of an inch per second, and a particle 0.0001 mm. in diameter, corresponding to his finest clay, would descend at the rate of 0.00064 mm. per second, or 0.1 of an inch per hour in still air.

The special interest that attaches to this present duststorm consists in its bearing on the question of the formation of our agricultural soils, and especially the so-called "loess," which is the lightest and finest of all. Large tracts of loess exist in Nebraska, Kansas, Iowa, and southward to the Gulf; in some places its depth amounts to a hundred feet or more. This light soil is easily raised and carried by the strong winds of our western plains; instances have occurred in which 6 inches of surface soil has been blown away from freshly cultivated fields in the course of a single windstorm. The dust that was caught on January 12 between two layers of snow in Indiana, probably did not differ in any material respect from that which is daily present in the atmosphere of that region, but its presence on top of the snow rendered it easy to gather the dustfall without contamination with the soil already existing. Those who wish to gather and examine the dust in the atmosphere may do so at any time by exposing a plate covered with a thin layer of glycerine in such a way that the wind may strike it. The higher this plate is above the ground, or above a valley, the smaller will be the average size of the particles. Dust of some form is always present in the atmosphere up to the tops of the highest mountains, and is a very important item in the matter of the formation of rain and in the radiation and absorption of heat. If the air had no ascending movements the very finest dust would eventually settle to the ground, although the finer particles would require weeks and months to do so; but, on account of the ascent and descent of the air, only the heavier particles fall to the ground by their weight; the finer ones are brought down from the lower atmosphere in connection with snow and rain; the finest of all undoubtedly float for many months in the very highest portions of the atmosphere, but eventually descend with fog, rain, or snow.

It might be thought that as the surface winds carry the lighter soils to greater distances in proportion to the fineness of the particles, therefore the finest particles would be found preponderating in the surface soil at great distances from those regions in Colorado, Wyoming, Nebraska, and Dakota, where the strong winds first begin to raise the clouds of dust. But Prof. Milton Whitney states that it has not as yet been demonstrated that the texture of the loess soils becomes finer and finer as we proceed from north to south, and the reason for this undoubtedly is that the regular geographical distribution of the coarse and fine particles, as first deposited by a strong wind, is altered by the action of the next strong wind that blows, so that there is an approximate uniformity throughout the watershed of the Mississippi and Missouri, due to the general action of all strong winds for many centuries. As the finer particles fall in great quantities upon the ocean they form an important item in the flocculent sediments that form at its bottom.

As this dust, or loess, formation, when it has once settled upon the ordinary soils becomes a new ingredient in their composition, those interested in this subject should study the mechanical analysis of soils and their relation to moisture as set forth by Prof. Milton Whitney in Bulletin No. 4 of the Weather Bureau.

METEOROLOGICAL TABLES.

[*Prepared by the Division of Records and Meteorological Data.*]

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only the 8 p. m. observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation.

The stations are arranged in geographical or climatological divisions, for each of which the mean temperature and average precipitation for the month are also given, together with their departures from normal values.

Generally the headings of the several columns are sufficiently explicit as to the data underneath.

The mean pressure is based on simultaneous observations taken at 8 a. m. and 8 p. m., seventy-fifth meridian (Eastern) time, which time is always understood unless otherwise expressed. Mean values thus computed differ from the mean of the 24 hourly readings by amounts varying from zero to 0.02 of an inch; the departures east of the ninetieth meridian are generally above the mean of 24 hourly readings and those west of that meridian are generally below. A comparison for each individual station can readily be made in connection with the data given in Table V.

The pressures have been reduced to sea level by the empirical method published by Prof. H. A. Hazen in Signal Service Professional Paper No. VI, which, however, has been further modified for a few high-level stations.

The mean temperature of the dew-point and the mean relative humidity are based on daily observations of the whirled psychrometer at 8 a. m. and 8 p. m. The psychrometric tables of Ferrel, as modified by Russell, are used (see Instructions to Weather Bureau Voluntary Observers, 1892), omitting the correction for atmospheric pressure.

The maximum wind velocities given in the table are the velocities as read from the sheets of the anemometer register for any 5-minute period in the twenty-four hours, midnight to midnight. The indications of the Weather Bureau Robinson anemometer can be approximately reduced to true velocities by means of Marvin's tables.

The number of clear and cloudy days and the average cloudiness are based upon numerous personal estimates by the observer during the daytime and do not relate to the nighttime. When these personal estimates give from 0 to 3 cloudiness, on a scale of zero to ten (0–10), the day is classed as clear; 4 to 7, partly cloudy; and 8 to 10, cloudy.

Table II gives, for about 2,400 stations occupied by voluntary observers, the extreme maximum and minimum temperatures, the mean temperature deduced from the average of