TORNADO AT ROSWELL, N. MEX.

By CLEVE HALLENBECK, Meteorologist.

[Weather Bureau Office, Roswell, N. Mex., June 15, 1923.]

The first tornado of record for the Pecos Valley of New Mexico and; according to pioneer residents, the first one ever known to occur in southeastern New Mexico, occurred at Roswell on the afternoon of June 8, 1923.

When first observed by the writer, at 3:48 p. m., the tornado cloud was about 15 degrees north of west, 7 miles distant, and suspended from near the southern edge of the nimbus area of an extensive, sluggish thunderstorm which at the time covered nearly half the sky. This thunderstorm had begun forming far up the west slope of the valley one and a half hours earlier, and was moving east-northeast against an east-southeast wind—a typical topographic thunderstorm such as is observed a score of times every summer. During the day, up to the time the thunderstorm began forming, strato-cumulus clouds moving in two directions were observed, the lower moving from the southeast and the upper from the southwest.

The tornado moved east-northeast, moving faster than the thunderstorm, and passed over the extreme northwest corner of Roswell, where it demolished a few houses, partly destroyed several others, and destroyed most of the barns, other outbuildings and windmills in its path. Two or three automobiles were wrecked, an airplane was stripped to its fuselage, a number of large trees were destroyed, and both wires and poles of electric lighting, power and telephone lines were torn down. Nearly a mile from the center of the tornado's path streets were blockaded by the branches, measuring up to 10 inches in diameter, that had been torn from the rows of shade trees lining the streets. The instrument shelters at two fruit-frost stations were blown over and two thermometers broken. There were no casualties, and only a few injuries. One entire family was badly mauled when the tornado played battledore and shuttlecock with the automobile in which it was riding, the latter became a shapeless wreck afterward, with its engine buried in the side of a hill.

When first observed by the writer, the tornado cloud was nearly vertical, with a ragged, truncated apex at least 150 meters from the ground. As it moved it became more and more inclined to the north, and when over the northwestern corner of the city was inclined fully 60 degrees from the vertical, while the base of the cloud had gradually grown wider, more ragged, and farther from the ground. In this manner it disappeared when about 10 degrees west of north of the station, becoming merged into the main cloud mass.

When nearest the station, the tornado was 1.5 mile due northwest, at which time a maximum velocity of 56 miles from the west was recorded at the station. Damage to buildings was confined to a path not more than 250 yards wide.

The tornado was accompanied by only a light rain, very little hail, and no thunder (except such as was due to its parent thunderstorm), but excessive precipitation, accompanied by a heavy fall of hail, followed along the same path an hour later. Buildings that remained standing in the path of the storm were plastered with mud on their west side, and spattered on their north sides, while both north and south sides bore scars and scratches made by flying gravel.

A number of individuals reported that three other tornadoes had previously formed in the southwest; that two of these were very short-lived, while the third passed directly over Roswell, high in the air, and when overhead "resembled a whirlpool in the clouds." These reports agree in all essentials, and very probably are true. The writer was busy, and saw but the last one, and very probably would have missed it had not an excited citizen called his attention to it.

The preceding account of damage done, etc., is compiled from accounts given the writer by people who visited the scene and not from personal observation, as he had no opportunity to inspect the damage himself.

DUSTFALL AT LUDINGTON, MICH., MARCH 25, 1923.

By CYRUS H. ESHLEMAN, Meteorologist.

[Weather Bureau, Ludington, Mich., June 25, 1923.]

A remarkable dustfall occurred at Ludington, Mich., and over an area extending east and west and a short distance apparently north and south, Sunday, March 25, 1923, between the hours of 4 and 6 a. m. Persons going out of doors noticed that the light snow which had fallen, amounting to about 0.4 of an inch, had a decided brownish tinge, and those who happened to be out earlier saw some of the dust come down with the snow. Capt. Michael Martin, of a Pere Marquette Line steamer, stated that when about 25 miles out from shore, bound for Manistee, he encountered the dust which came down like a great cloud of smoke.

The writer gathered some of the snow and dust and melted the snow. At first the sediment looked dark, but when it dried it again became brownish. Its composition was decidedly fine and powdery. Samples were sent to the University of Michigan, the Michigan Agricultural College, and the University of Wisconsin. An analysis was made also by one of the science instructors of the Ludington High School. All the reports of examination stated that organic matter was present. Numerous minerals were also identified. The general character, it was stated by Prof. Walter F. Hunt, of the University of Michigan, was that of loess such as is found at places in the Mississippi valley.

In the meantime numerous inquiries were mailed to Weather Bureau stations and other institutions or persons, with the view of learning the extent of the dust area. The replies to these inquiries indicate that the territory was 150 miles or more in length, from central Michigan across Lake Michigan into Wisconsin; and probably not more than 10 to 20 miles in width, though it is possible that to the north where snowfall was heavier the dust was thus hidden from sight.

The dustfall was unquestionably an unusual one, at least for this vicinity. A rough estimate of the total weight of the dust over the whole area, judging from that collected from a few square yards, would be at least 100 tons. Everywhere—on roofs, porches, sidewalks—after the snow melted the dust was noticeable. Even several months afterward on rough flat roofs some remained.

HEAVY RAINS IN SOUTHERN KANSAS, JUNE, 1923.

A. J. HENRY, Meteorologist.

[Weather Bureau, Washington, D. C., Aug. 1, 1923.]

The occurrence of heavy rains in the trans-Mississippi region is always an interesting meteorological event, whether considered as a purely meteorological phenomenon or in the light of its economic effects. It is to be remembered that, in Kansas, where abundant rain means so much to the agriculture of the State, too much rain, on the other hand, means large loss to crops along river bottoms.

An account of the floods in the Arkansas Valley and the rains which produced it is given elsewhere in this REVIEW. (See p. 329.) Attention is here directed to the heavy rains of June 7–9, which apparently culminated at Wichita in a 24-hour fall of 6.68 inches on the 8th–9th. The magnitude of this rainfall was clearly a result of a favorable pressure distribution over the territory embraced between the Texas Panhandle in the southwest and lower Michigan directly to the northeast. A line connecting these two points passes directly over southeastern Kansas. The exceptional feature of the rainfall was the rather narrow zone of greatest intensity, which seems to have paralleled the Arkansas River valley, although full reports are needed to outline its exact distribution.

The pressure distribution.—By reference to Charts I and II (see track No. 1 of Chart I and track No. 3 of Chart II) it may be seen that on the morning of the 7th an anticyclone had advanced from Canada to South Dakota, as a result of which northerly winds prevailed over Kansas and Nebraska. In the succeeding 24 hours this anticyclone moved eastward to Minnesota, thus causing east and southeast winds over Kansas and at first light rain. Pressure was low in the Rocky Mountain region, and by the morning of the 9th a weak cyclone had advanced to the Texas Pandhandle. Central pressure in the anticyclone had increased to 30.30 inches in the meantime, thus producing a moderate gradient for southeast winds over Kansas. Surface temperatures were lower to the westward than to the east and southeast, and we must assume that the warmer and moister air that passed over Kansas overrode the colder air to the west and northwest, thus lowering its temperature to the dewpoint and causing continuous precipitation over a time that depended on the rapidity of movement of the cyclone and anticyclone, respectively. There was practically no movement of these, or very little movement on the 10th, and the rainfall continued in Missouri and Arkansas on that date.

The writer has previously found that heavy rains in Kansas [1] depend largely upon the slow movement of cyclones over the State in conjunction with anticyclones situated over Minnesota or the lake region.

From a consideration of these facts it seems reasonable and justifiable to believe that the occurrence of a pressure distribution favorable to heavy rainfall, heavy because continued for several hours, is a consequence of the orderly sequence of weather events and is not necessarily to be referred back to the pressure distribution at some previous time in a far distant place. In other words, that the vicissitudes of rainfall, whether light or heavy, are intensely local rather than general.

[1] MO. WEATHER REV. 43: 287.

NOTES, ABSTRACTS, AND REVIEWS.

THE SIZE OF METEORS.

[Reprinted from *Science*, New York, June 22, 1923, page viii, of supplement.]

That meteors as bright as the brightest star are no bigger than small bird shot is a conclusion drawn by Prof. F. M. Lindeman and Mr. C. M. Dobson, authors of a recent article in the *Proceedings of the Royal Society*. A meteor as bright as the moon would, they find, be only an inch in diameter and would weigh about 2 ounces.

As a result of their study, the authors conclude that the temperature of the upper atmosphere is much higher than was formerly supposed. It has long been known that the fall of temperature with altitude continues only to a height of about 7 miles, where the temperature is as low as from 60° to 70° below zero Fahrenheit. But from this altitude as high as sounding balloons have gone, which is about 15 miles, the temperature has remained about the same. This is what is known as the stratosphere or isothermal layer.

The recent investigators of meteors now conclude that this layer of fairly constant temperature extends up to a height of 30 miles, above which the temperature again rises, so that at altitudes of from 30 to 50 miles it reaches considerably above the freezing point, or about the average temperature at the earth's surface.

The density of the air at a height of 60 miles is calculated to be one-millionth of that at the surface. It is thought to be composed largely of ozone, and its high temperature is thought to be due to heating by the long-wave length heat waves from the surface of the earth.

GLACIOLOGY.

By C. S. WRIGHT and R. E. PRIESTLEY.

This splendid quarto volume of xx plus 487 pages, 179 figures, 291 halftone plates, and xiv folded maps, is one of the several reports of the British Antarctic Expedition under the lamented Capt. R. F. Scott.

The chief topic is, of course, snow and ice, but also there are many interesting references to Antarctic weather (a subject ably discussed in another report of this expedition by Dr. G. C. Simpson) and polar climates. Meteorologists especially will find a hopeful interest in the possibility of a logical seasonal forecast in the region of McMurdo Sound. "Unless the Sound freezes early, before the advent of winter establishes the large horizontal temperature gradient between sea and land ice, the high winds caused by this temperature gradient favour rather the retention of existing conditions and are strongly against the freezing of the Sound late in the winter. We see, therefore, that the climatic conditions of the autumn months—March and April—are, in McMurdo Sound, those which decide the winter conditions in this region. It is circumstances of similar nature which cause the large differences between the climate in any one region, from one year to another."

As is well known, it is far from self evident how enough precipitation is obtained over the Antarctic, and then retained, despite evaporation, summer melt, and blizzard drift, to keep the entire continent perpetually coverep with ice and snow. This puzzling problem is discussed, and the several methods by which precipitation is induced fully explained. Although neither accurate nor even approximately accurate measurements of either precipitation or ablation (loss by whatever process, except glacial flow) are possible in the Antarctic, the annual snowfall over the two to three million square miles of the low-lying barrier appears to be the equivalent of 12 to 24 inches of water. Approximately 7½ inches of this is the net annual gain that maintains the outward flow of the barrier ice.

In the chapter on the formation of ice crystals from vapor the important conclusion is reached that the form and nature of the snow or frost crystal depend essentially on the rate at which the crystal is grown, and not upon the temperature. Considerable attention is given to the