CLOUD DISSIPATED BY KITE.

J. A. RILEY, Meteorologist.

[Weather Bureau Office, Broken Arrow, Okla., Sept. 14, 1923.]

On July 29, 1923, during a kite flight at the Broken Arrow, Okla., station one of the kites caused a rift in a layer of thin clouds as the kite was being lowered through it. This phenomenon may be of interest in connection with recent reports of rain making and cloud dissipating by airplane.

The clouds on this morning were predominately alto-cumulus with some patches of very small fleecy balls that would have been recorded as cirro-cumulus from their appearance had not their altitude been determined by the kites. A very thin alto-stratus veil spread among the more compact masses of alto-cumulus.

The kites were obscured by this thin cloud layer as they were being reeled in, when presently one of the kites cast its shadow on the clouds: this shadow was visible to the observers at the reel house for perhaps two minutes. Then the kite entered the cloud stratum and a rift in the cloud began. It rapidly lengthened in the lee of the kite and looked as if the kite were a plow making a long straight furrow in the cloud. The opening was somewhat wider than the kite and more than 2,000 feet long as determined by angular measurements, when it was closed by the kite being lowered out of the cloud. The rift was visible as a straight dark line for several minutes afterward as it drifted away.

Contrasted with this dissipating of clouds is the formation of cloud bands by the passage of airplanes through previously clear air of high humidity, as recorded in "The Argonne Battle Cloud."[1] The two processes are not necessarily related however. The evaporation of the cloud particles is undoubtedly the result of the deflective action of the kite on the air passing through it.

The clouds were 2,800 meters high, with a velocity of 8 m. p. s. from the west, and a temperature of 7° C. (45° F.). Below the cloud there was a nearly normal lapse rate of temperature; above there was a sharp but limited inversion. As the kite entered this inversion layer this warm air was deflected down into the cloud with the result that the cloud particles were evaporated.[2]

The total amount of cloudy condensation evaporated was, of course, relatively small; it is only because the cloud stratum was very thin that an opening in it was made. Usually the clouds are far too thick to be affected by the small deflection in the air caused by the kite.

Streaks in the clouds have previously been observed during kite flights, twice at Mount Weather, Va., and once each at Drexel, Nebr., and Ellendale, N. Dak.[3]

Mr. V. E. Jakl states that—

> This phenomenon has come under my observation twice. In the case of Drexel on July 9, 1917, and at Ellendale on January 15, 1918, we find in the former case an abrupt inversion and drop in humidity at about the level where the streak started downward. In the Ellendale case, the tabular record shows no inversion, but shows increasing humidity and formation of alto-cumulus up to the level where the streak was observed to begin. In both these cases it appears that the kite was far below the cirro-stratus in which the streak was observed. However, what appeared to have been a streak in the cirro-stratus might have been simply greater visibility developing in a line in a thin stratum of air where cloudiness was incipient, this greater visibility evidently caused by the evaporation of the tenuous clouds, similar to the dissipation of the actual clouds observed at Broken Arrow.
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> The electrical theory mentioned by Dr. Blair (MO. WEATHER REV., June, 1917) seems plausible enough, in the light of recent experiments on dissipation of clouds by charged sand, but has the objection that if this were so we would observe the streak phenomenon more often, and when observed, it should be more permanent.

[1] MO. WEATHER REV., June, 1921.

[2] At the cloud level the lapse rate was about 0.9° C. per 100 m. as shown by the record, or approximately adiabatic. Hence the atmosphere at this level was nearly in neutral equilibrium. Clearly, then, the downward deflection of the air carried that portion of the cloud just beneath the kite to a considerably lower and warmer level. Furthermore the loss of heat, due to the evaporation of the depressed cloud, slightly increased the distance of fall and consequent ultimate warming of the descending air.—*W. J. H.*

[3] MO. WEATHER REV., June, 1917. 45: 269-270; and SUPPLEMENTS No. 11, p. 5, and No. 12, p. 6.

FORECASTING RAIN ON THE WEST TEXAS COAST.

JOSEPH P. MCAULIFFE, Meteorologist.

[Weather Bureau, Corpus Christi, Tex., Sept. 6, 1923.]

Rainfall, the most important meteorological element in most regions, becomes doubly important on the west coast of Texas, since the relatively small amount received annually bears an important relation to the yield of crops. It is very important, therefore, that weather forecasters have a thorough knowledge of the subject in order that those rather infrequent rains may be accurately forecast for the benefit of farmers.

An effort has been made by the writer to determine the character of the atmospheric disturbances that most frequently cause precipitation in this region, and to this end a careful study of the most important rains has been made, the period under discussion being the years from 1902–1922, inclusive. Only the rains that were of material benefit to crops have been selected, those amounting to 1 inch or more in 24 hours.

A striking feature of these heavy rains has been the fact that the great majority of them have occurred with the prevalence of a north or northeast wind—48 per cent of the rains occurring with these wind directions. The north wind predominates with rains of 1 inch or more in 24 hours, being 28 per cent of the total. Northeast winds give 20 per cent of the rains, while east and southeast each have 18 per cent, south 9 per cent, southwest 2, west 1, and northwest 4 per cent.

The question now arises: What is the character of the atmospheric disturbance causing these heavy rains, and what location must it have with reference to this locality in order to give precipitation? In the great majority of cases the rain-producing LOW overlies the Rio Grande Valley, with a well defined HIGH to the northeast. Often a Gulf disturbance will be the cause of the great rains of this region, but these disturbances frequently move inland and become Rio Grande LOWS, so it may be assumed that the majority of the rain-producing disturbances are of the latter type. Any depression that moves far south, especially in winter, and comes through New Mexico, thence to south-central Texas, may cause precipitation on this coast, but there are many instances where the LOW will swing northeastward through northern Texas after reaching the vicinity of Roswell, New Mexico, and when this happens it becomes either a "dry LOW" for this region, or one with very little precipitation. When, however, a large HIGH impinges on one of these western LOWS in the Rio Grande Valley north and northeast winds result, with an abundance of

rainfall along the west Texas coast. It matters little what the season of the year, rainfall will almost always occur with a LOW in the Rio Grande Valley, and a HIGH over the region to the northeast.

Of course there are many exceptions to this rule, and rain may occur with a south wind, but the data for twenty years show plainly that heavy rains with southerly winds are rather rare in this region. In most cases the LOW is advancing towards the Rio Grande Valley, and will at first cause southerly winds, but soon easterly to northerly winds will set in, and then the rain will become general, heavy, and long continued.

Often the southward advance of a northwestern HIGH will cause precipitation without the presence of any well defined LOW over Texas, but with only a "relative LOW" over extreme southern Texas caused by the abnormally high pressure advancing from the Northwest. Thus it occurs that many "northers" in winter, spring, and fall are attended by general and sometimes heavy rains. Frequently these rains on the west Texas coast are little more than mists that come in with the north and northeast winds, but they often persist for several days, and cease only after the HIGH has advanced well into Texas or has passed entirely out of the western half of the country.

A peculiar feature of the influence of the sea coast on wind direction in this region is the fact that a northwest wind seldom persists for a long time. The "northers" that cause strong northwest winds in central Texas reach this coast as a northeast wind, or when sufficiently strong, cause a northwest wind for a short time, then shift to north, and finally to northeast. It is this tendency for a northwest wind to become a northeaster that causes the mists referred to above. It also tempers the cold waves, because the wind blows over the water surface when it comes from the northeast. Frost and freezing temperature are therefore prevented from reaching this coast, except in the unusually severe cold waves.

It would seem from what has been said that it is an easy matter to forecast rain on this coast, the wind direction being the principal element to consider. As a matter of fact it is rather a difficult problem until the rain begins, as it is often uncertain where the LOW will advance when it is coming from the southern Rocky Mountains, and when it comes through Mexico it may cause rain before its presence is observed. After precipitation begins it is safe to assume that it will continue until the Rio Grande Valley LOW moves out or dissipates. These LOWS are usually sluggish, therefore a forecast for 24 or 36 hours ahead is not difficult once the rain begins. Occasionally, however, they advance rapidly, and a rain forecast for a certain period will occur before the verifying period begins.

In conclusion it may be said that local forecasters in this area should remember that light and infrequent precipitation occurs on this coast except when north to east winds prevail, generally induced by a Rio Grande LOW. Forecasters, therefore, should be wary about forecasting precipitation with an advancing LOW unless the central depression is far south, generally below Amarillo, and it is expected that the depression will move into the Rio Grande Valley. On the other hand, they should not forecast a cessation of precipitation with a Rio Grande LOW until it is certain that it will move entirely out of the Valley, and this is usually a slow process when a HIGH checks it.

WATERSPOUTS NEAR CORPUS CHRISTI, TEX.

By JOSEPH P. MCAULIFFE, Meteorologist.

[Weather Bureau Office, Corpus Christi, Sept. 18, 1923.]

A waterspout occurred over Corpus Christi Bay during the morning of September 12, 1923 under conditions that were most favorable for observation and study. Unfortunately, however, no photographs were made of it.

The phenomenon formed during a morning that had given moderate to heavy local showers and squalls. It was the first occurrence of its kind since 1917, and the most perfect waterspout that has ever been observed so close to the city of Corpus Christi. Occasionally these phenomena are seen on the Gulf of Mexico, but seldom in the bays along this coast.

The writer was on the roof of the Federal Building examining the rain-gauge when his attention was attracted by heavy peals of thunder in the northeast. A thunderstorm was approaching the station from that direction. As the squall cloud advanced rapidly a thin pendent cloud suddenly appeared, waving to and fro and twisting irregularly, much like a pennant suspended horizontally, flapping in the breeze. This was exactly 10:31 a. m. The pendent cloud extended rapidly downward, and by 10:35 a. m. had touched the surface of Corpus Christi Bay, apparently 10 miles east-northeast of the station. The column was now straight as a plumb line, intensely black, except that a thin gray streak extended throughout its center from the cloud mass to the water. The spiral motion of rotation was plainly visible, and it caused a great agitation of the water surface over which it passed, causing water and spray to rise to a height estimated at 10 feet. The direction of the spiral motion was usual for such phenomena, i. e., counterclockwise. The waterspout advanced rapidly from the northeast, breaking away somewhat from the main thundercloud, which advanced from a more easterly direction. At 10:40 a. m. the middle part of the pendent cloud made a sharp bend toward the south, leaving the upper and lower portions a little in its rear. A few minutes after this the waterspout broke into two parts, the upper part drawing up into the main storm cloud, while the lower part advanced onward toward the southwest, causing the agitation of the water surface to continue. In its last stages the only part of the waterspout visible was a twisting mass of spray moving rapidly across the bay. This disappeared when within a mile of the city and a half mile northeast of the Municipal Pier, where motorboats and skiffs were moored. This was exactly 10:44 a. m. The diameter of the waterspout was estimated at 40 feet. The entire distance traveled by the cloud after touching the water was about 12 miles, and it covered this distance in nine minutes. A sharp squall came in from the bay immediately after the disappearance of the waterspout, giving a maximum velocity of 26 miles an hour from the east at 10:46 a. m. Only 0.01 of an inch of rainfall occurred, the heavy rain area passing north of the station.

Fishermen returning from the Gulf reported having seen two waterspouts during the same day, and at different times and places. One of these was reported a few miles east of Corpus Christi Pass (about 12 miles southeast of the station), while another was seen in the Laguna Madre, probably 15 or 20 miles southeast of Corpus Christi. Neither of these was as large as the one observed over Corpus Christi Bay.