AMPLIFICATION OF WEATHER FORECASTS.*

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The purpose of this paper is to promote the understanding of Government weather forecasts and to encourage the making of local predictions by persons whose working hours are spent for the most part in the open air.

The time at the disposal of the forecast official of the Weather Bureau at the central office in Washington city for the purpose of forecasting probable weather changes, cold waves, and severe storms is about thirty minutes in the morning and forty at night. It is impossible in this short time to do more than express the character of the anticipated changes for each state or district east of the Rocky Mountains in any but the most general terms. The local, or state forecast official, on the other hand, is concerned with but a single district. He is at liberty to amplify the national forecasts or to put forth a statement of his own, in which the anticipated changes may be given in as much detail as the conditions seem to justify.

Persons who use the forecasts constantly should cultivate the habit of carefully noting the weather changes in their respective localities, especially the sequence in which such changes occur, for it is only by acquiring a knowledge of local weather signs that

as used by the forecast, is less positive than "fair" alone. It signifies that the probability of fair weather over the whole district and for the entire period is not so great as when "fair" alone is used.

"Partly cloudy" is another expression that is used when the indications favor clouds but no precipitation. "Threatening" is used when in the judgment of the forecaster the weather will be overcast and gloomy, with the appearance of rain or snow at any moment, yet a measurable amount of precipitation is not anticipated.

A forecast of "rain" or "snow" may be expressed in various ways. In the late fall, early spring, and the winter season it is most commonly indicated by the single word "rain" or "snow," as the case may be, thus: "Rain to-night." And when used in this form it is expected that the rain will continue for several hours. In other seasons of the year any one of the following terms, viz., "local rain," "showers," and "thunderstorms," may be used. Local rain and showers are almost identical in meaning. The word "thunderstorm," of course, carries its own significance. Any one of these terms indicate that the rain will not be general over the whole state or district. The most marked feature of precipitation in the warm season, as compared with the cold, is its unequal distribution over

of weather which follows. In this way and without special effort a fund of weather wisdom is soon acquired which needs only to be properly correlated in order to serve a most useful purpose. The greatest advantage will naturally accrue to the individual who reads and accurately interprets, not only the Government forecasts, but also the local weather signs. In the remainder of this paper the local signs of falling weather will be briefly described.

CLOUDS.

Clouds are formed from the moisture that is always in the air, in varying quantities, even over the desert. Like the air itself, the moisture that is within it is invisible so long as it remains in the form of a gas. When a mass of air is cooled by any means whatever a portion of its water-vapor is condensed and becomes visible—a mist or cloud is formed. A familiar illustration of cloud formation in nature is afforded when a current of warm, moist air strikes a cold mountain. The colder surface of the mountain condenses some of the moisture that is in the air, forming a cloud which frequently obscures the top of the mountain and floats away in the prevailing winds. This simple phenomenon indicates to an observer on the leeward side of the mountain that a warm, moist current

FIG. 1.—CIRRUS CLOUDS.

Light, feathery clouds that float at an elevation of 4 or 5 miles above the earth's surface. When in the form of plumes with frayed or torn edges increasing cloudiness and rain or snow are indicated.

FIG. 2.—CIRRUS, MERGING INTO CIRRO-STRATUS CLOUDS.

A transitional form often seen when rain or snow is approaching. The cloud layer gradually thickens until the sky is obscured.

FIG. 3.—FAIR-WEATHER CUMULUS CLOUDS.

These clouds, it should be observed, have level bases and rounded tops without the dome-like structure of figures—a type of cloud often seen after a spell of rain.

FIG. 4.—CIRRO-CUMULUS CLOUDS.

Small round masses of clouds usually at an elevation of 4 or 5 miles above the earth's surface. These clouds are typical of fair weather.

they can use Government forecasts to the best advantage.

DAILY WEATHER FORECASTS AND THEIR TERMINOLOGY.

The Weather Bureau issues from its Washington office two forecasts daily, at about 10 A. M. and 10 P. M., respectively. The observations on which the forecasts are based are made at 8 A. M. and 8 P. M., Eastern standard time. The morning forecast covers a period of twenty-four hours, beginning at 8 P. M. of the day on which the forecast is issued. The first twelve hours of the period is always referred to as "to-night;" the second is given the name of the day to which it may refer. Thus, "Fair to-night and Tuesday" would be the form of a forecast issued at 10 A. M. Monday. "To-night" in this case would begin at 8 P. M. Monday and run until 8 A. M. Tuesday, while Tuesday would end at 8 P. M. of that day, not midnight, as some might suppose. The forecast made at 10 P. M. is for a period of forty-eight hours. A forecast made on Monday night would take the form "Partly cloudy Tuesday and Wednesday." This forecast, it will be observed, does not apply to the night of either Tuesday or Wednesday.

"Fair weather"—that is, the absence of rain or snow—is indicated by several terms. The first of these is the words themselves. It may be used singly or be preceded by the word "generally." "Generally fair,"

relatively small areas. A shower cloud may form and pass over several counties or it may dissipate within 5 miles of its origin. Indeed, we may say that it is only in exceptional cases that general and continuous rains fall in the summer season. In some seasons local rains may occur in some part of a State every day in the month, but the science of meteorology is not yet far enough advanced to delimit the path of a local shower and the exact time of its occurrence.

Forecasts of local rains, showers, or thunderstorms indicate that the conditions are favorable for the occurrence of precipitation in the district and for the given period.

"Clearing" is a word frequently used which carries a broader meaning than the word itself signifies, viz., the occurrence of precipitation in the early part of the period; thus "Clearing to-night" would indicate that rain or snow, whichever might be falling at the beginning of the period, would cease shortly thereafter and that the weather would be clear during the greater part of the time.

LOCAL SIGNS OF FALLING WEATHER.

Persons whose working hours are largely spent in the open air soon become familiar with the changing aspects of the sky and the condition of the atmosphere as to its moisture content, viz., whether relatively dry or humid. If careful observers of natural phenomena, they note also the shift of the wind and the sequence

of air, with probably rain or snow, is approaching. In some parts of the world the formation of a cloud cap on a mountain top is not an indication of precipitation, yet in the majority of cases it is believed to be a reliable prognostic of falling weather. In general, the formation of clouds after a clear spell is the first sign of coming rain. Unfortunately, there is no definite interval between the time of the first appearance of clouds and the occurrence of rain. Rain may not fall for several days after the first appearance of clouds, and, on the other hand, it may begin within two or three hours after the first cloud makes its appearance.

The various cloud-forms generally observed in the United States, with their especial significance, are given in our engravings.

THE TEMPERATURE AND MOISTURE OF THE AIR.

An increase in the amount of moisture in the air is indicated in various ways. It is especially noticeable to the senses when coupled with a high temperature. Man does not need a thermometer to tell him that the air is oppressively warm, nor a hygrometer to tell him that there is an unusual amount of moisture present. A pitcher of ice water on a hot summer day is not a bad sort of hygrometer. The pitcher is naturally cooler than the surrounding air, and consequently some of the water-vapor in the air is condensed and collects on the outside of the pitcher. It will be remembered that water-vapor changes to the liquid state when the

* From the Yearbook, United States Department of Agriculture for 1900.

air is cooled below a certain point. The principle illustrated by the pitcher of ice water is repeated on a grand scale in nature every time rain or snow falls. First, there is the cooling of the air and the formation of cloud, the latter being composed of minute particles of water; second, there is the further cooling of the cloud mass, so that its particles join to form small raindrops, which fall to the earth by their own weight. When a rain cloud strikes the top of a mountain, rain does not necessarily fall, but small mist-like particles of water are deposited on the relatively colder surfaces of the rock and other objects on the mountain sides and top. Those particles coalesce and run down the sides of the objects on which they are deposited precisely as frequently happens on a pitcher of ice water on a warm, humid day. If the mountains were warmer than the cloud mass there would be no condensation, but some of the moisture of the cloud would be evaporated and float away in the prevailing winds.

An unusual amount of moisture in the air in summer produces a feeling of closeness; physical labor is more enervating than when the air is dry and crisp. The change from sultry, oppressive weather is nearly always brought about by a series of thunderstorms, sometimes lasting over two days.

Summarizing the indications that may be drawn from the temperature and moisture of the air, it would appear that an increase in the amount of moisture in the air is a sign of change from fair to foul weather,

must be clear weather and unobstructed sunshine. It is easily seen, then, that all such winds must be most active in fair weather, and that when they cease, or fail to appear at the usual time, the atmosphere as a whole must have come under an influence greater than that which produced the diurnal winds.

In the open country or other exposed situation where the true direction of the wind can be determined, it should be noticed first, what is the prevailing direction of the wind in fair weather, and what is the direction from which storms usually come. The direction of the wind during the twenty-four hours immediately preceding the storm should be especially noticed. To do this a short journal or diary of the weather should be kept. The direction of approach of storms in the United States varies in different localities. It is quite important that each observer determine for his immediate neighborhood the shift of the wind with the approach of storms, during the colder months at least.

In the warm months the winds are light and rather variable, and changes in direction have not the same importance as in the colder months. The rain of summer generally occurs in connection with thunderstorms; it will be found that these are most frequent for a certain direction and with the wind in a particular quarter. Beyond the fact that more thunderstorms come from a westerly quarter than from any other direction, little can be said that will be of

(1) The changes in the aspect of the sky; (2) the direction of the wind before, during, and after the storm; and (3) the shift of the wind, whether with or against the sun.

The clouds that precede the storm by from twenty-four to thirty-six hours are almost invariably light, wispy cirrus, of the general character shown in Fig. 1. Soon after the appearance of clouds of this class a sheet cloud forms at a slightly lower elevation and gradually thickens until the sun is hidden. Fig. 2 illustrates the sheet cloud in the first stages of formation.

The subsequent clouds are much darker than those above mentioned, and appear to form at much lower elevations. When the sky becomes overcast the wind generally freshens, the temperature rises, and the air becomes humid; in popular speech, "it feels like rain."

LOW PRESSURE AND HIGH PRESSURE.

The weather experienced from day to day depends upon the frequency and the course followed by areas of low pressure, and the succeeding areas of high pressure which generally follow them. These are exceedingly variable, both as to direction and rate of movement. Some move rapidly from the Northeastern Rocky Mountain slope to the maritime provinces of Canada at a uniform rate, while others have a rapid rate of progression at the beginning, but quickly slow down and finally cease to move. There are, however, certain characteristics possessed by both highs and lows, which, if once fully understood, would greatly assist the individual observer in making a forecast of the weather for the morrow.

CONCLUSION.

The foregoing few generalizations apply equally

FIG. 1.—PRIEST SACRIFICING A VICTIM. FIG. 2.—SUN GOD AND PRIEST.

FIG. 3.—FIRE BASIN.

both winter and summer. In the colder months an increase in the temperature of the air above the average for the season, coupled with an increase in moisture, is a sign of rain or snow within twenty-four to forty-eight hours. In the summer an increase of temperature alone is not always an indication of rain. But these are not infallible rules. The old proverb, "All signs fail in dry weather," is as true to-day as when first formulated.

THE WIND AND ITS SUCCESSIVE CHANGES.

The wind is less prophetic in character than the clouds, since it is affected by the form of the land over which it blows. Thus, it has a tendency to blow up a valley in the daytime and in the contrary direction at night, no matter in what direction the valley may extend. Winds also have a tendency to blow toward and up the sides of a mountain slope in the daytime and down the side of a mountain at night, and this movement of the air generally extends for some distance out from the foot of the mountain on the level slopes. There are also the well-known land and sea breezes of all countries where, during the twenty-four hours of the day, the temperature of the land becomes alternately warmer and colder than that of the sea. These winds (valley, mountain, land, and sea breezes) are called diurnal winds. They are caused by differences in temperature that are not general, but confined to the valley or mountain slope of a particular locality. In order that these differences of temperature may arise there

value in forecasting their approach by the direction of the surface winds only. The coming of a thunderstorm can generally be foretold a few hours in advance by the form and movement of the clouds.

In the colder months, viz., November, December, January, February, March, and April, the winds are stronger than at other seasons of the year, and storms also move with greater rapidity. The signs of falling weather in the colder months are the formation of a high sheet cloud covering the whole sky, an increase in the temperature and moisture of the air, and the change of the wind to some easterly quarter. The precise direction that the wind takes, whether northeast, east, or southeast, varies for different localities and the direction from which the storm is approaching. In New England, the Middle States, and the Ohio Valley, northeasterly winds precede storms that approach from the southwest, and southeasterly winds precede storms that approach by way of the lake Region. On the Pacific coast southeasterly and southerly winds precede rain storms. In Wyoming and other Northwestern States the heavy snowstorms of winter and spring generally come from the north or northwest with a strong wind from the same direction. The direction of the wind depends very much on the position of traveling storms that pass across the country.

The storms of the cold season have certain well-marked characteristics that should be easily recognized by every worker in the open air. These are:

well in all parts of the country east of the Rocky Mountains. They will be found most useful, however, in the middle and upper Mississippi and Ohio Valleys, the Lake Region, and the Middle States. As soon as they are thoroughly understood the local observer will be able to detect in the atmospheric changes, apparent to the eye or apprehended by the sense of feeling, the coming of an area of clouds and precipitation with its attendant whirling winds—warm on the front and right-hand side and cold in the rear and on the left-hand side.

THE SCULPTURES OF SANTA LUCIA COZUMA-HUALPA, GUATEMALA, IN THE HAMBURG ETHNOLOGICAL MUSEUM.*

By HERMAN STREBEL.

THE scientific committee of the Hamburg-American Celebration, planned for 1892, had intended to hold an exhibition, and Director Bolau, Mr. L. Friedrichsen, Superintendent C. W. Lüders, Dr. Michau, and the author of the present paper were associated into a sub-committee for that purpose. As everybody knows, the cholera broke out and rendered this promising part of the programme impracticable. It thus became necessary to make some other disposition of so much of the material collected as had been either

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