

## The Daily Weather Map and Its Major Functions

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Mark Twain once remarked, "everybody talks about the weather but nobody does anything about it." That may have been true in the days of Mark Twain but hardly is a truism today. Much is being done about the weather, especially in regard to learning more about the physical reactions which take place in the upper atmosphere and which are in turn largely responsible for the great varieties of weather as experienced in Indiana.

The increased knowledge of the physics of the air has made possible, among other things, a more accurate forecast of weather activities. Weather phenomena and changes do not just occur; rather they are the result of orderly and explainable physical reactions which take place in the gaseous envelope which surrounds our planet. Whenever one is able to forecast accurately these physical reactions and to foresee their movements across the country, accurate weather predictions are possible.

Among the numerous weather phenomena which result from physical reactions in the atmosphere are: air masses, fronts, wind, temperature, pressure, humidity, clouds, dewpoint and precipitation. The weather forecaster, when making a prediction, must consider each of the above mentioned elements and evaluate the significance of each phenomenon upon future weather. In order to evaluate the elements the forecaster must have a clear and concise mental picture of each weather phenomenon at his station and all surrounding stations. This picture he secures by means of the daily weather map, a synoptic chart, which shows the existing weather conditions over the entire United States. The data, which is plotted on the synoptic map, is secured at approximately 200 weather stations at exactly the same hour or 1:30 a.m. Eastern Standard Time. A complete daily weather map of the United States is made at each of the 200 stations. Numerous stations publish the map for local distribution. The Washington D. C. map is printed for country-wide distribution and is available to anyone at a nominal charge. Institutions which post the map for public use receive the map free of charge.

Although a discussion of the methods followed in securing weather data and procedures employed in drawing the weather map are intensely interesting, the purpose of this paper is to explain the map itself and discuss its numerous functions. These functions are of great importance to the weather forecaster, airplane pilot, farmer, fruitgrower, nurseryman, those engaged in water and land transportation and the average layman. Numerous other functions might be enumerated, but the list stated above emphasizes the importance of the daily weather map.

Prior to the summer of 1940 the Weather Bureau was administered by the United States Department of Agriculture. However, in August, 1940, the Weather Bureau was transferred to the Department of Commerce where it still remains. In its new environment the Bureau gained new impetus. The weather map was greatly improved in regard to the information presented. Figure 1 shows a portion of the Daily Weather Map as published prior to August 1940 and figure 2 is a reproduction of a part of the map after the Bureau was transferred to the Department of Commerce.<sup>1</sup>



Fig. 1. A section from the United States Weather Map as it appeared prior to August 1940.

A comparison of figures 1 and 2 shows readily the increased amount of data presented on the latter figure. On the older map wind direction, amount of cloudiness, kind of precipitation, temperature and barometric pressure were shown. Areas of high and low pressure were also indicated on the map. Wind directions were shown by arrows, which flew with the wind. The degree of cloudiness at each station was shown by circles which were blocked out according to the amount of sky obscured by clouds. Kinds of precipitation were indicated in the station circle by upper case letters as "R" for rain and "S" for snow. Dashed lines, called isotherms, and drawn through stations having equal temperature, were used to show temperature. Light continuous lines, called isobars, were drawn through points of equal sea-level pressure and indicated barometric pressure. The isobars also marked the shape and extent of the areas of high and low pressure.

<sup>1</sup> All of the maps and charts presented in this paper are reproduced from the Daily Weather Map and are used by written permission from the United States Weather Bureau.

The Daily Weather Map, as described, served for many years as a basis of weather forecasting and served its purpose well. However with a rapidly mounting interest in air traffic and automobile transportation in the 1930's a demand for more weather information steadily increased. The development of new and more precise weather instruments also opened up a wider knowledge of the physical reactions of the atmosphere and these made possible more accurate and extended weather predictions. In order to present a synoptic picture of the more extensive data available a new type of daily weather map was made. Figure 2 presents a reproduction of the new type of Daily Weather Map as now published.

Meteorological data secured at approximately 200 selected weather stations are included on the present map. This information includes di-

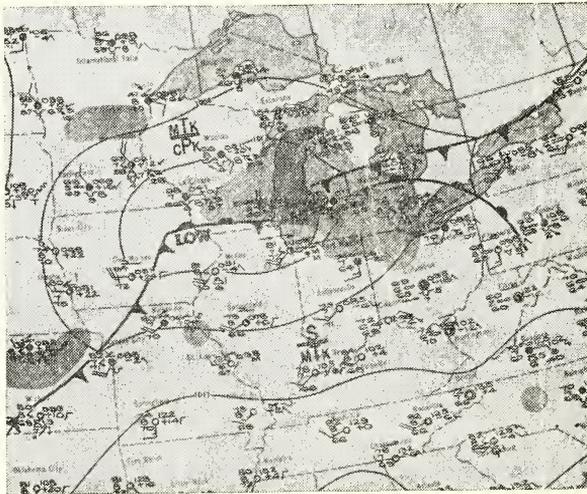


Fig. 2. A section from the United States Weather Map as it is produced at present.

rection and velocity of the wind, barometric pressure reduced to sea level, amount and type of precipitation, present and past weather, temperature, dew point, kind and amount of clouds, visibility and the pressure tendency. Other meteorological data of infrequent occurrence such as tornadoes or hailstorms are also indicated as needed.

In order to present the data enumerated above in an orderly and easily readable manner each is shown by means of figures or symbols and always occupy the same relative position around the station circle. The station circle with all of its accompanying data is referred to by the meteorologist as the Station Model. (Fig. 3.)

Wind direction is denoted by a shaft extending from the station circle toward the direction from which the wind blows. The number and lengths of feathers on the shaft indicates the velocity of the wind. Table 2 on figure 4 shows the symbols used to indicate wind velocity.

Figure 4 is a partial reproduction of a complete explanation found on the reverse side of the Daily Weather Map. Other tables of symbols show Barometric Tendencies, Cloud Symbols, Station Model, Present Weather Symbols and an explanation of Fronts and Air Masses.<sup>2</sup>

Barometric pressure at sea level is shown in figures at the upper right of the station model. The pressure is stated in "tens", "units" and "tenths" of millibars, the initial 9 and 10 being omitted. On figure 3 the pressure is 247 which means a barometric reading of 1024.7 millibars. The net amount of barometric change in the 3 hours preceding that of observation is shown immediately to the right of the station circle. In figure 3 the change has been 2.8 millibars; the + sign indicates the

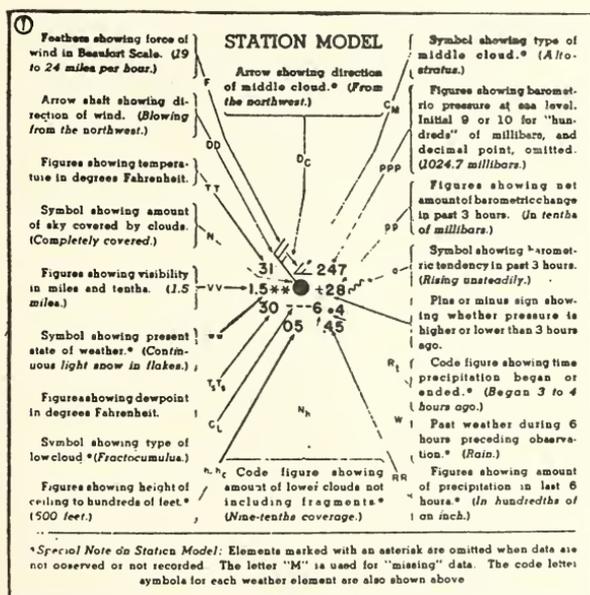


Fig. 3. The Station Model with explanation of data.

pressure is higher than 3 hours ago. The wavy rising line to the right of the figure 28 indicates the barometric tendency, datum of basic significance in weather forecasting.

Within the station circle a cloudiness symbol is drawn to indicate the amount of sky obscured by clouds. The portion of the circle which is blacked out shows the per cent of sky obscured. Table 3 in figure 4 presents the cloudiness symbols and percentage value of each.

The state of weather current during the period of observation is shown by a symbol immediately to the left of the station model. In case

<sup>2</sup> A complete explanation of the code symbols used on the Daily Weather Map may also be found in: (1) Haynes, C. B., *Meteorology for Pilots*, Bulletin 25, United States Printing Office, Washington, 1943. (2) Numerous good texts on *Meteorology* also show the symbols used on weather maps.

the weather is fair or the cloudiness symbol in the station circle adequately describes the current weather the weather symbol is omitted. One hundred three states of weather are classified by the Weather Bureau. These symbols have been drawn to represent actual weather conditions as accurately as possible. For example, a “.” for rain; an “\*” for snow and a “,” for drizzle are typical. The number and arrangement of symbols represent the intensity of precipitation. In the station model shown in figure 3, the present state of the weather is shown thus “\*\*.” This symbol indicates continuous light snow in flakes. On the face of the map (Fig. 2) black dot shading shows areas where precipitation was falling at time of observation.

② BEAUFORT SCALE OF WIND FORCE			③ VALUES FOR N SYMBOLS AND N <sub>c</sub> FIGURES		
NUMBER	SYMBOL	MILES PER HOUR	N	N <sub>c</sub>	AMOUNT OF SKY COVERED BY CLOUDS
	☉	Calm.	○	0	No clouds. (Figure 0 not entered on map.)
1	☉	1 to 3.	①	1	Less than one-tenth.
2	☉	4 to 7.	②	2	One-tenth.
3	☉	8 to 12.	③	3	Two- to three-tenths.
4	☉	13 to 18.	④	4	Four- to six-tenths.
5	☉	19 to 24.	⑤	5	Seven- to eight-tenths.
6	☉	25 to 31.	⑥	6	Nine-tenths.
7	☉	32 to 38.	⑦	7	More than nine-tenths, but with openings.
8	☉	39 to 46.	⑧	8	Ten-tenths, or completely covered.
9	☉	47 to 54.	⑨	9	Sky obscured.
10	☉	55 to 63.			
11	☉	64 to 75.			
12	☉	Above 75.			

Fig. 4. A part of the reverse side of the Daily Weather Map, the whole of which presents a complete explanation of the data appearing on the face of the map.

Kind of weather that has been experienced during the 6 hours preceding the observation is shown to the lower right in the station model. Past weather, time precipitation began or ended and amount of precipitation are entered. Whenever the letter “T” appears in place of the measured amount of precipitation, less than 0.01 of an inch has fallen. The amount is then recorded as a trace.

To the upper left of the station circle figures indicating the temperature in degrees Fahrenheit are entered. Directly below the state of the weather entry, figures showing the dew point in degrees Fahrenheit appear. On the weather map only two isotherms, lines connecting points of equal temperature, are drawn. Dashed lines, labeled Freezing, and

dot-dash lines, labeled Zero, are drawn through points where the current temperature is 32° F. or 0° F., respectively. The freezing and zero isotherms separate areas in which temperatures are above and below 32° F. or 0° F.

To the left of the state of the weather symbol on the station model figures are entered which give visibility in miles and tenths of miles. In figure 3, for example, visibility is one and five tenths miles.

Directly below the station circle a symbol is entered to indicate type of low clouds. If no such clouds exist no symbol is used. Below the low cloud symbol figures are placed to show the height of the ceiling to hundreds of feet. Directly above the station circle is entered a symbol to indicate type of middle cloud. Above the middle cloud symbol is placed the high cloud symbol. No such entry appears on figure 3 since high clouds were nonexistent or not visible. A study of actual cloud formations and the symbols used to show these clouds indicate the symbols have been drawn to correspond closely with cloud shapes.

On the face of the weather map (Fig. 2) appear the words "High" and "Low". These terms indicate centers of high and low barometric pressure of air masses. Air masses are classified into several different types according to their origin and basic characteristics. These masses are represented on the weather map by labels such as mTk, cPw and mTw. The label mTk is explained as follows: m indicates the mass formed over the ocean; T means it formed in tropical latitudes and the letter k shows the temperature of the air mass is colder than the surface over which it is moving. cPw may be explained as follows: c = formed over a continent; P = polar latitudes and w = warmer than surface.

Heavy lines called "Fronts" separate air masses of different characteristics. The front bounding the forward edge of a cold air mass is known as a cold front. It is indicated on the weather map by placing triangular points on the "front" line. Fronts preceding warm masses of air are called warm fronts and are shown by half circles on the map. The side of the line on which the triangles or half circles are placed indicate the direction in which the front is moving. Frequently a cold front overtakes a warm front. The line where such a junction occurs is called an occluded front. The boundary between two air-masses which show little tendency to move is known as a stationary front.

A front which is disappearing or decreasing in intensity is labeled "frontolysis", while a front that is forming or increasing in intensity is labeled "Frontogenesis".

On July 1, 1944, more meteorological data was added to the face of the Daily Weather Map in the form of three maps. In the lower left corner of the sheet is printed a weather map which shows the pattern of isobars and location of existing fronts for an observation made 12 hours previous to that of the large weather map or at 1:30 p.m. of the previous day. In those areas where precipitation was falling at 1:30 p.m. a black dot shading is used. A comparison of the 1:30 p.m. map and the 1:30 a.m. map reveals how the pattern of air masses and fronts has changed in the previous 12 hours. Such information is basic in formulating accurate forecasts of future weather.

Another small map is printed in the lower center part of the map. This map shows precipitation areas and amounts which occurred during the 24-hour period prior to the observation time of the large weather map, or 1:30 a.m. Areas where precipitation occurred are shown by black dot shading, while figures indicate the amount of precipitation in hundredths of an inch. The letter "T" appearing on the map indicates a trace of precipitation. There are 168 weather stations on the map.

In the lower right hand corner of the Daily Weather Map is a small map showing the maximum and minimum temperatures which occurred at the 168 selected weather stations in the United States during the 24-hour period ending at 1:30 a.m. The upper figure at each station is the highest temperature and the lower figure is the lowest temperature recorded during the 24-hour period. The black dot shaded portions cover areas where the temperature at 1:30 a.m., or time of observation for the large map, is at least 10 degrees higher or lower than the temperature was 24 hours previous, or at 1:30 a.m. the previous day. Should the letter "M" appear on the map, that indicates missing data for that station.

The Daily Weather Map is a basic tool for the meteorologist. A succession of three or four maps presents a continuous picture of weather changes. The forecaster is able to determine the speed of air masses and fronts; to determine whether an individual pressure area is deepening or becoming more shallow; whether a front is increasing or decreasing in intensity. The meteorologist is also able to determine whether an air mass is retaining its original characteristics or taking on those of the surface over which it is moving. Although the above stated information is only a portion of that necessary in taking accurate weather predictions, individually and collectively it is basically essential. Of course, all the data entered on the Daily Weather Map has its specific function in weather forecasting. Thus, it becomes clear that the most significant function of the map is that of presenting a synoptic picture of the physical conditions existing in the atmosphere at a given time. This picture is then employed by the meteorologist as an aid in forecasting future weather.

As stated earlier in this paper a detailed discussion of the procedures followed in making the Daily Weather Map would be interesting and informative. Equally interesting would be the methods used in making weather predictions. However, such descriptions are not the functions of this discussion, and must therefore be omitted.

Although the primary function of the Daily Weather Map is its use by the meteorologist it could be of much greater value to the average citizen. However, the laymen seldom becomes well enough informed to interpret or to gain much value from the map. This is indeed unfortunate since as has been shown in the foregoing pages the map is hardly as complicated as it may first appear. The average person would gain more acquaintance with the map were it more widely printed in daily newspapers and used by more business concerns.

In November, 1944, a new feature was added to the weather map which is of prime importance to various groups of people. Several

times a week, special charts are printed on the reverse side of the weather map in place of the usual "Explanation of the Weather Map," as already shown in figure 3. An example of charts found on the reverse side of the Daily Weather Map is shown in figure 5.

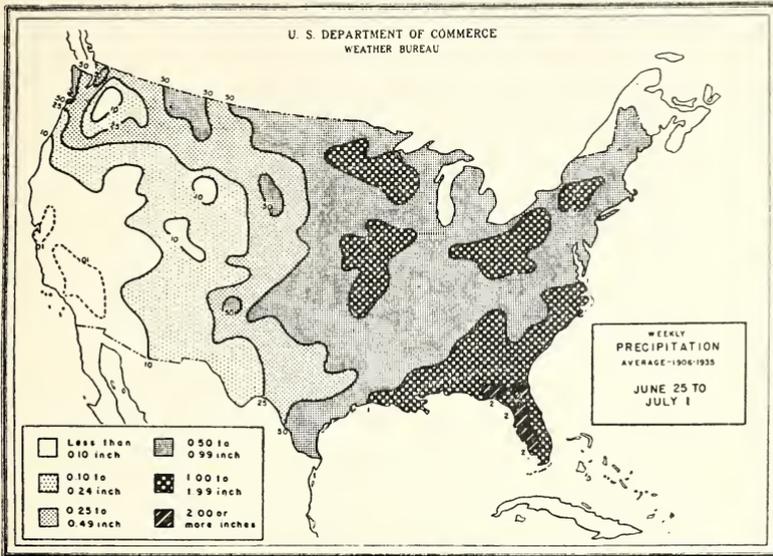


Fig. 5. An example of the special information which appears frequently on the reverse side of the Daily Weather Map.

Since this new service was begun nearly two years ago, 194 charts have been presented and discussed to date. (Oct. 1, 1946) These charts may be divided into thirty-four subject matter groups as follows:

1. Temperature charts
2. Precipitation charts
3. Wind and Sunshine charts
4. How the Daily Weather Map is Made
5. How Hurricanes are Shown on Weather Maps
6. Spring Weather and the Home Gardener
7. Cloud Types and Pictures
8. It Isn't the Heat, It's the Humidity
9. Tornadoes
10. To Alaska by Air
11. River and Flood Forecasting Service
12. Weather and Vacations
13. Minute Men in Storm and Flood
14. The Fruit-Frost Service
15. The Weather and Cranberries
16. Raisins and Rain Warnings
17. Weather and Bananas

18. Grain Spoilage and Rainfall
19. Weather in Walla Walla
20. Fire-Weather Forecasting
21. Forecasting Storms on the Great Lakes
22. Weather and the Railroad
23. Storms and Shipping
24. Aviation and the Weather Map
25. Meteorological Service to Airways in the United States
26. A Series of Analyzed Charts
27. Pilot Balloon Stations in the United States and Alaska
28. Radiosonde Stations in the United States and Alaska
29. Ice Storm of December 27, 1944
30. Meaning of Degree Days
31. The Structure of Fronts
32. Pilot Balloon Observations
33. The Beaufort Wind Scale
34. The Ohio River Flood of Mar. 5-6, 1945

Certain charts are presented each month of the year, such as the charts showing temperature, wind, and sunshine, and precipitation. A part of the latter chart for June 1946 is reproduced in figure 5. Special charts showing a detailed analysis of local unusual storms are frequently presented. Typical titles of such charts are: The Cold Wave of Jan. 7-9, 1945; The Midwest Storm of Feb. 21-22, 1945; Pre-Cold Front Weather, May 7-8, 1945; Heavy Rains in Eastern United States, July 15-19, 1945; The Duststorm and Blizzard in the Midwest, Feb. 5-6, 1946 and The Spring Snowstorm in the Rockies, May 9-10, 1946. Two and three sets of charts are often used to explain these unusual phenomena. Because of the wide-spread interest created by certain charts, they are frequently reprinted. For example, the following charts have appeared at least twice: "Cloud Types and Pictures", "Tornadoes", "Spring Weather and the Home Garden", and "It Isn't the Heat, It's the Humidity".

An examination of the titles and subject matter of the charts indicates that certain ones would be of greater interest to one group of people while other charts would appeal more to other groups. In the list of thirty-four subjects stated earlier, it is obvious that the first thirteen titles would be of interest to the general public. However, subjects fourteen to nineteen inclusive, would appeal more to the agriculturalist. On the other hand subjects twenty to twenty-five inclusive would hold special interest for those groups associated with the various types of transportation.

Further examination of the titles listed should indicate that many will hold considerable interest for several groups of people. All of the charts are informative and easily understood. The Weather Bureau uses special care in preparing the material appearing on the charts so that it will be as non-technical as possible. It is to be hoped that the Weather Bureau will continue to offer these valuable charts for use by

the general public. The charts add materially to the value of the Daily Weather Map itself.

Only a few statements are needed to summarize this discussion. The Daily Weather Map is a synoptic chart of the weather conditions as they exist over the United States at 1:30 a.m. Eastern Standard Time. The data used in preparing the map is secured from approximately 200 selected weather stations and located in all parts of the country. The map presents a picture of the distribution of air masses and fronts for the time of observation. At each weather station is placed a station model in which appears meteorological data pertinent to the forecaster in making weather predictions.

On the back of the Weather Map there appears frequently special charts which present information pertinent to farmers, transportation groups, fruit growers, meteorologists and the general public. The charts are presented in a clear and simple manner and are highly informative.

The Daily Weather Map and the special charts offer to the laymen a valuable service relative to the weather both past, present and future. It is the obligation of each well informed citizen of the United States to become acquainted with this service and profit from it.