The WEATHER *for* RADIO

LISTENERS, BROADCASTERS AND OTHERS

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BY

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Taylor Instrument Companies

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CONTENTS

THE WEATHER

I

MARK Twain's comment that everybody talks about the weather but no one seems to do anything about it will some day lose its significance, because we are steadily adding to our knowledge of the weather and soon shall do much about it. The ancients observed weather phenomena and built up a considerable lore in an effort to either account for weather changes or to forecast them. But only during the past 50 years have we really made progress in a scientific study of atmospheric variability. This investigative work has been carried on by a handful of patient pioneers. We need more people to join in the research and help these faithful few.

Universality Weather is the common subject of conversation among the peoples in every "corner" of the earth. In the northeastern part of the United States and northwestern Europe where tremendous changes occur in short periods of time and in rapid succession, remarks about the weather are probably more frequent than in the lowlands of the Tropics where the weather-changes from day to day are not so striking. Yet even in such regions, the occurrence of the daily afternoon thunderstorms, the velocity of the storm winds, and the variations in humidity give occasion for some discussion. Again in the hot desert, the native is concerned with sand storms which impede his travel and often imperil his life; or, on the other hand, he bends in thankful prayer when a rare cloud precipitates a little moisture for the first time in a year, or two, or three years. The variability of his weather may not be so great as that in the areas of a humid intermediate climate, but none-the-less vital to him.

Everyone experiences days when he feels uncommonly well—"full of pep," and again days of depression, or languor, or of restlessness. A thousand and one reasons may underlie these changes in our state of health, but careful correlation between the variability in our physical and oftentimes mental condition, and the barometric pressure or atmospheric humidity will show a very close relation. High pressure makes us "up and doing" while days of low pressure virtually sap our energy. If each person observed his particular reaction to these changes in the state of the atmosphere and then watched the barometer from day to day he could often profit thereby, consciously adjusting himself to a low or high barometer, understanding just how either level affected him.

Radio Awakens Interest

During the past three or four years and more especially during the past two years, the acquisition of radio sets by millions of people has aroused a new interest in the weather. People who heretofore have paid but little attention to the weather, beyond simply noting that "it's a fine day today" or "it's pretty stormy today," now show considerable concern about it, because they have made the discovery that the weather apparently affects the clarity of reception. The public is especially concerned when, after looking forward for weeks to hearing a stellar performance, the anticipated program is spoiled by a pandemonium of static—all because the weather was not right.

Urban residents, unlike our farmers, have rarely considered the weather seriously. They are not ordinarily impressed by local crop failures even if prices rise because the total effect is shared by many and the inconvenience to any single person is small. The farmer, on the other hand knows well the seriousness of the situation because his loss may send him into bankruptcy. So it seems we have waited for the invention of a device which gives us pleasure, to make us appreciate the desirability of solving the weather problem. As good roads had to await the coming of the pleasure automobile and later the convenient auto truck and bus, so the creation among the public of a scientific interest in the weather has had to await the marvels of radio.

The whole subject of radio transmission is so young we may still say that we know almost nothing about it. As with electricity, whose behaviour we understand, but whose nature we can't explain, so with radio, we appreciate its basic principles but cannot explain the transmission itself. Among the many factors affecting transmission and reception, we are confident the atmosphere is one, but we need more oberservations than we have and we need as many students of the problem as we can possibly interest, in order to determine accurately, the part which the atmosphere plays.

Weather Effects on Radio Recent studies of the relation between the weather and radio have led to the following conclusions:—

1. If a line connecting the receiving station with the broadcasting station crosses the intervening isobars at right angles, reception is at its best.
2. The steeper the isobaric gradient (that is, the closer the isobars to each other) the stronger the reception.
3. The more nearly the transmitted waves approach parallelism with the isobars, the weaker the reception. Under these conditions fading occurs.
4. Reception in a Low Pressure area tends to be somewhat weaker than in a High of corresponding intensity.
5. Reception is weaker when the transmitted waves cross from one pressure area into another than when they travel only within one area.
6. Reception is accompanied by static when transmission crosses any part of a warm humid Low or crosses an area adjacent to an intensely-developed humid Low whose surface temperatures are above freezing.

   If precipitation throughout the Low is in the form of rain static will be pronounced, but if snow or ice, little or no static will occur.

7. The strength of reception for any station is a factor of both its location within a pressure area and its position with respect to the broadcasting station.

8. "Bad weather" does not affect reception, excepting as it may be the index of an unfavorable pressure distribution.

9. Reception can be as good in "bad weather" as in good weather if the pressure distribution is right.

10. Temperature does not influence reception, except as it may be the index of pressure distribution and strength of convection circulation as follows:

    (a) Reception is better in winter than in summer because the cyclones and anti-cyclones are more intense in the winter period.

    (b) Reception is better when temperatures are low than when high, be cause low temperatures usually indicate intensive high pressure areas, that is, areas with steep isobaric gradients.

    (c) High temperatures favor strong convection, a condition favorable for static.

    (d) In poorly defined high pressure areas reception is poor.

11. Shallow or flat pressure areas favor much static.

An Opportunity In order that those who are interested in pursuing the problem farther and who do not have an acquaintance with the behaviour of the atmosphere as indicated upon the daily weather map, may be better equipped to carry on an investigation, we submit a brief statement in non-technical terms relative to the present knowledge of the atmospheric circulation and append a short bibliography where more extended discussions are available. The field is one of great importance and the opportunity for each one to render a service to his fellowman should attract many. Two possibilities appear in connection with these studies, namely, the determination of the exact relation between weather and radio reception and transmission on the one hand, and on the other, the discovery of the exact behaviour of the circulation of the atmosphere which may lead to increased efficiency in both daily and long range weather forecasting.

THE WEATHER MAP

II

Collecting Data The United States Weather Bureau has established some 200 stations throughout the country where weather data are recorded daily. Most of the observations are made by self-recording instruments for every minute of the day, and others, such as clouds and accurate barometer readings, must be made by the observers themselves on duty at the respective stations. Twice daily, 7 a.m., and 7 p.m., Central Standard Time, the height of the barometer, temperature, precipitation, wind direction and velocity, cloudiness and the occurrence of unusual phenomena, are telegraphed to Washington, D. C., and to certain district offices where the data are recorded and a weather map drawn. The morning map is printed for general distribution and is always in the mail by about 11 a.m. In addition to data within the country, some are reported from Canada and from islands in the Atlantic and Pacific Oceans and from trans-oceanic countries. All of these latter data, however, do not appear on maps printed outside of Washington. A typical weather map is shown in Fig. I.

Isobars and Isotherms On the weather map, Fig.1, appear conspicuous areas labeled "Low" or "High", cyclones and anticyclones, respectively. These are pressure areas and are formed by drawing isobars (mean-

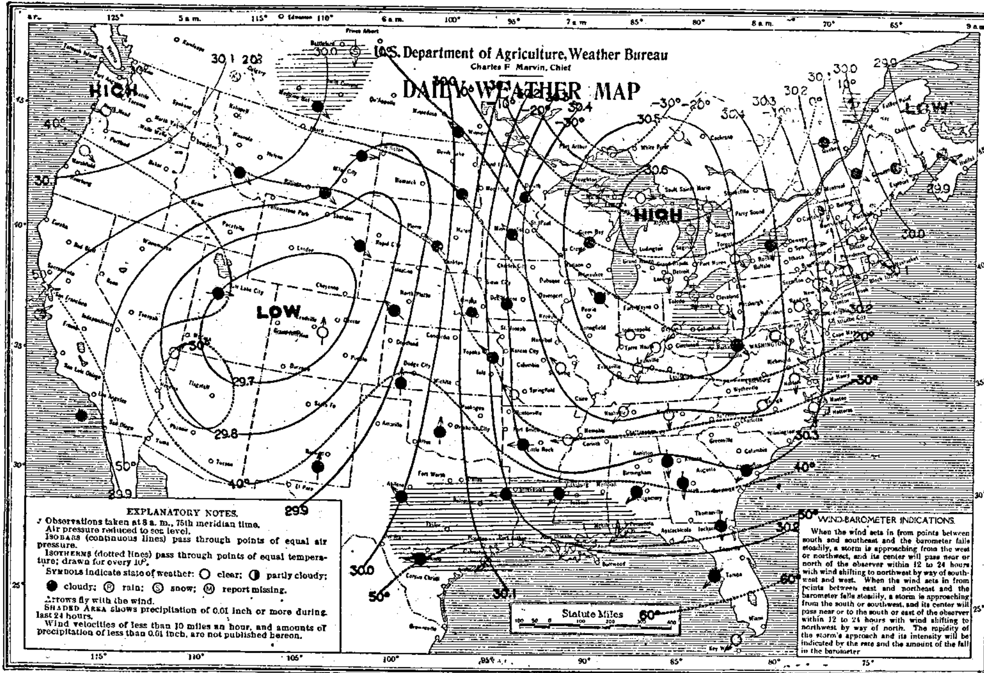
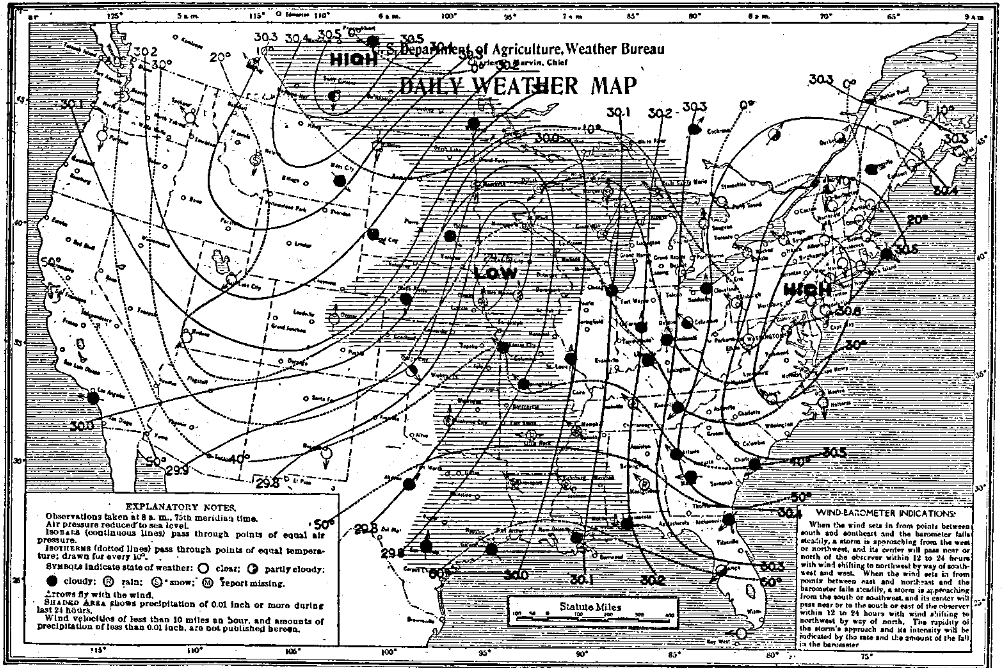

U.S. Department of Agriculture, Weather Bureau
Charles F. Marvin, Chief
DAILY WEATHER MAP
HIGH
LOW
HIGH
LOW
EXPLANATORY NOTES.
Observations taken at 8 a. m., 75th meridian time.
Air pressure reduced to sea level.
Isobars (continuous lines) pass through points of equal air pressure.
Isotherms (dotted lines) pass through points of equal temperature; drawn for every 10°.
Symbols indicate state of weather: ○ clear; ◑ partly cloudy; ● cloudy; Ⓡ rain; Ⓢ snow; Ⓜ report missing.
Arrows fly with the wind.
Shaded Area shows precipitation of 0.01 inch or more during last 24 hours.
Wind velocities of less than 10 miles an hour, and amounts of precipitation of less than 0.01 inch, are not published hereon.
WIND-BAROMETER INDICATIONS.
When the wind sets in from points between south and southeast and the barometer falls steadily, a storm is approaching from the west or northwest, and its center will pass near or north of the observer within 12 to 24 hours with wind shifting to northwest by way of southwest and west. When the wind sets in from points between east and northeast and the barometer falls steadily, a storm is approaching from the south or southwest, and its center will pass near or to the south or east of the observer within 12 to 24 hours with wind shifting to northwest by way of north. The rapidity of the storm's approach and its intensity will be indicated by the rate and the amount of the fall in the barometer.
Statute Miles

Fig. 1

ing equal pressure) through all points having the same pressure. In addition to isobars are broken isotherms (meaning equal temperature) passing through all points having the same temperature. The values of both isobars and isotherms are appropriately indicated at their termini.

Sequence of Lows and Highs Further examination of the map develops the fact that the Lows and Highs alternate. This is true on all maps, except that occasionally a single Low or High may have two centers, one primary and the other secondary; but this occurrence does not affect the truth of the statement relative to their alternation, for these two centers merely represent divisions of a large unit.

In Fig. 2 which is the map for the day succeeding Fig. 1, the whole system of Lows and Highs has moved eastward by a distance of 600 to 1000 miles or at the rate of about 35 to 40 miles an hour for the preceding 24 hours. This is essentially the average speed of an express passenger train. The Low that was centered over the Rocky Mountains, Fig. 1, has moved to Iowa; the High over Michigan has reached the Atlantic Seaboard, while the Low over Maine has disappeared from the map and is probably over the Banks of Newfoundland. This succession of pressure areas is a continuous performance, varying only now and then by a change in the rate of movement, or the shifting of their courses to the northward or to the southward, some following one path, some another.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HIGH
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Statute Miles

Fig. 3

Storm Paths All of these *storms*, as the weather man calls them, move in a general easterly direction. Only the tropical hurricane, (a Low), moves westward, starting from its place of origin somewhere near the equator in the mid-Atlantic, moving toward the West Indies and Florida, and then turning northeastward along the Atlantic coast where it conforms with the normal easterly movement of storms. Sometimes the intensity of these tropical hurricanes or cyclones is so great that before recurving they reach beyond Florida to the west coast of the Gulf of Mexico, as was the case of the destructive Galveston Storm of 1900.

The paths which the Lows and Highs follow are not fixed. The maps Figs. 3 and 4 clearly emphasize this point. The paths are numerous; most of the storms enter the country from the northwest, move into the Mississippi Valley and pass off the scene via St. Lawrence River Valley. But this is a very general statement to which exceptions are so numerous as to necessitate caution against assuming a typical path for any storm. This variability in paths offers one of the most difficult obstacles facing the forecaster.

We can recognize certain seasonal tendencies in storm paths, but even these vary so much that in a given season we have no assurances as to the exact track which a Low or High will follow. In the winter season Highs are well formed and follow fairly clearly defined paths either from western Canada across the Great Lakes region to the Atlantic or from the western plateau region southeastward to the Atlantic. Lows, in winter,

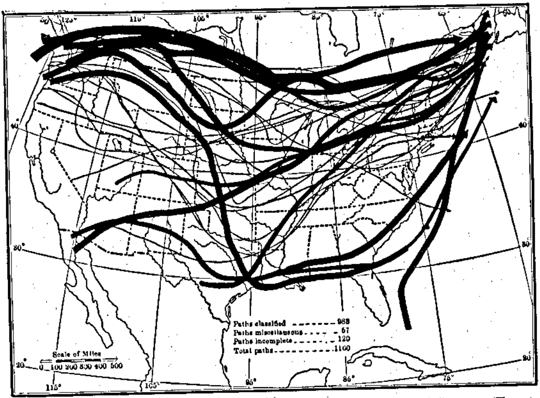


Fig. 127. — The Van Cleef System of Storm Tracks across the United States. (Twenty-seven Tracks are represented.) (U. S. Weather Bureau.)

Fig. 3

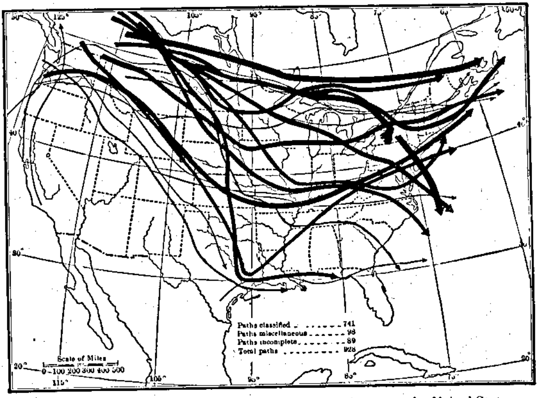


Fig. 128. — The Van Cleef System of Tracks for Highs across the United States. (U S. Weather Bureau.)

Fig. 4

(NOTE: Figs. 3 and 4 are reproductions of Figs. 127 and 128 in Milham's Meteorology)

enter the country from the northwest and follow either eastward across the northern Great Lakes region and down the St. Lawrence River Valley, or southeastward to the Gulf of Mexico and then northeastward along the Atlantic Coast. A third path lies about midway between the two just described. The paths of Highs in summer are quite indefinite. Summer Lows, while generally better developed than Highs, nevertheless follow somewhat more definite paths. They move from the southwest toward the Lake region and down the St. Lawrence, or from the northwest across the Great Lakes and down the St. Lawrence.

In the conclusions on the relation between radio reception and weather, p. 6, the statements focus largely upon the behaviour of reception with respect to the pressure distribution, that is, the distribution of Lows and Highs as related to broadcasting and receiving stations. In order that the reader may fully appreciate the statements and himself make observations which he may readily interpret in terms of the atmospheric pressure, it will be worth while looking at a cross-section of these pressure areas to observe the different kinds of weather which they evidence.

LOWS AND HIGHS

III

Pressure Gradient Before proceeding further, we should review the meaning of air pressure and gradient. The pressure of the atmosphere is recorded in inches read upon a barometer scale. The normal pressure at sea level is taken as 30 inches, or equal to the length of a column of mercury which the air will support. Stated in more familiar terms, the air weighs 15 pounds to the square inch under normal conditions at sea level. When the pressure reading is below 30 inches we call it *low* and when above we term it *high*, hence the corresponding expressions on the weather maps. The lowest reading in a Low and the maximum pressures in a High occur in their respective centers. If the pressure difference between the centers of any couplet of Highs and Lows is considerable in a short distance, the isobars, which are always drawn for every one-tenth of an inch variation in pressure, will be close together and then we say the gradient is steep; if pressure differences are small the isobars will be few and far apart and then we note the gradient is slight or even flat.

The Low (Cyclone) Its Characteristics In the "Low" over Utah and Colorado, Fig. 1, the arrows showing wind directions at given stations point, in general, toward a common center. Under ideal conditions, where the earth's surface might be uniformly level and consist wholly of land or water, the winds in a Low would blow counter-clockwise, spirally inward and upward. Even under the conditions of reality they closely approximate this circulation. Since in the southern half of a Low the winds blow, in general, from the south, the temperature ranges from warm to hot while those in the northern half of the area blowing from the northerly points of the compass are cool to cold. As a consequence of the warm air blowing northward and rising at the same time, it is cooled and the moisture in it condensed at upper levels. Partial condensation results in cloudiness; where condensation proceeds far enough to produce large droplets of water too heavy for the upward currents of air to support, the drops fall to the earth as rain; should condensation occur at freezing temperatures then snow is precipitated. The cloudiest and rainiest portion of a Low generally is in the southeastern quadrant, as appears in all of the Lows on the accompanying maps. Exceptions of course, occur, but not so often as to invalidate the general assertion just made.

Since the weather Bureau forecaster is acquainted with the above facts and also knows the rate of movement of the pressure areas, he can approximate how far storms west of his station will move in the ensuing 12 to 24 hours, what part will pass over his station, and consequently what the weather is likely to be in his vicinity. Individuals other than weather bureau officials can forecast for themselves, although for them it is more difficult because they do not possess all the data which are in the hands of the weather man.

Nevertheless, individuals may do much successful forecasting.

High (Anticyclone) Its Characteristics In the High over Michigan, Fig. 1, the circulation of air is in a direction opposite to that in the Low. The wind arrows point away from the center and, if their arrangement be closely observed, we may easily identify a movement described as spirally outward and clockwise. Since the air moves out from the center it must descend at the center. It is cool dry air whose temperature rises as it descends and therefore it evaporates moisture at the earth's surface. Consequently, this air induces clear skies, as shown on the maps by clear circles distributed throughout most of the High, especially along its eastern front.

As indicated, temperatures in Highs are likely to be lower than in Lows because the air descends from upper levels, but on the rear margin, in the transition area toward the Low, the air has travelled some distance along the earth's surface and therefore is considerably warmed. Northerly winds in a High are cool. Their effect upon temperatures is strikingly shown in the High discussed here, in which the isotherms bend far to the south, an index of the strong inflow of cool air.

As with the Lows so with the Highs, the forecaster can determine the weather for the next 36 hours by observing the distribution of atmospheric conditions in a High to the west of his location and observing the rate of movement of the storm area.

We have said that the rate of movement of these storms may be greater or less than the specified speed of 35 to 45 miles per hour. The question arises then, how may we determine this variability? On the weather maps just discussed the isobars do not appear everywhere equi-distant. For example, in Fig. 1 between the High in the Northwest and the Rocky Mountain Low they are far apart, while between this Low and the Michigan High they are close together. This means a steeper gradient in the latter case than in the former; it means stronger winds, too, and a more rapid movement of the Rocky Mountain Low toward the Michigan High, than of the Northwest High toward the Rocky Mountain Low. As a matter of fact, as shown in Fig. 2, the Northwest High moved in the next 24 hours about 600 miles, while the Low moved 725 miles.

We may briefly summarize the salient features of Lows and Highs, Fig. 5. The circulation of air in the Low is counter-clockwise spirally inward and upward, while that in the High is clockwise spirally downward and outward. The Lows are generally accompanied by warm moist air giving rise to clouds and at times precipitation, while the Highs are characterized by cool dry air and clearing conditions. In winter our cold waves are the accompaniment of Highs, while in summer warm waves are associated with Lows. However, we can not lose sight of the fact that neither the Lows nor Highs operate independently. They are interdependent and the status of the one affects that of the other.

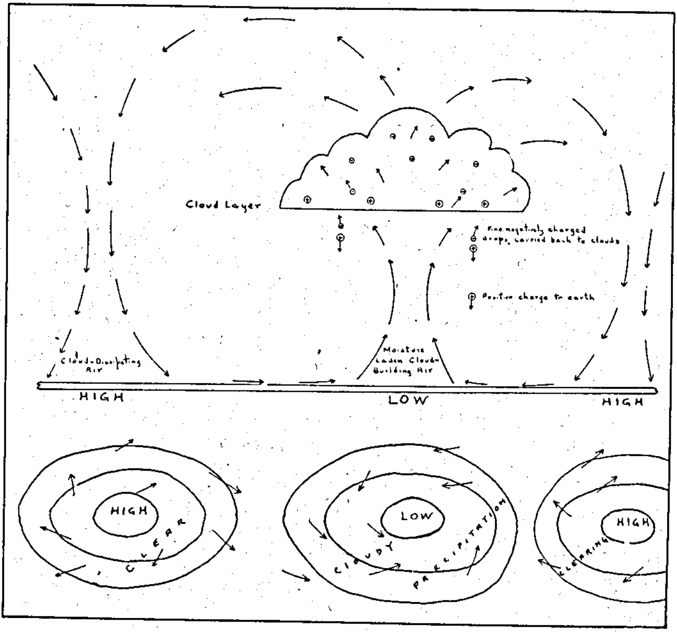

Cloud Layer
Fine negatively charged drops, carried back to clouds
Positive charge to earth
Cloud-Dissipating Air
Moisture Laden Cloud-Building Air
HIGH
LOW
HIGH
HIGH
CLEAR
LOW
CLOUDY
PRECIPITATION
HIGH
CLEARING

Fig. 5

THUNDERSTORMS AND STATIC

IV

The thunderstorm as an atmospheric phenomenon, characteristic of nearly all climates in middle latitudes, is familiar to most people. We recognize it either by the lightning flash or, when no lightning is visible, by rumbles of distant thunder. The calm before the storm, the sudden outrush of air with its whirlwinds and dustclouds, the ensuing torrential downpour—all are common knowledge. But the interpretation of the mechanics of the storm are not so well known and the extent of the responsibility of thunderstorms for the occurrence of static in radio continues in the realm of uncertainty. It seems, therefore, worth while to indicate briefly those conditions most favorable for thunderstorm formation and their possible relation to the cause of static in our receiving sets.

Thunderstorm Formation Moisture, heat, and convection are fundamental to the existence of thunderstorms. Given a moist surface under a hot sun and an atmosphere which is relatively dry, that is, in a state which will readily permit it to take up water vapor, evaporation of the surface moisture will proceed freely. This process establishes a convection current which attains a strength dependent upon the availability of the moisture, the dryness and calmness of the air, and the intensity of the heating. As the moisture-laden air rises, it cools by expansion. Condensation becomes effective when the dewpoint is reached and then cumulus clouds form.

When the condensed water vapor is converted into drops so large that they become too heavy to float, in other words too heavy for the air to support, they begin to descend as rain. Now, if in the condensing process extra large or so-called oversize drops form, they may be broken up into droplets of varying sizes, en route toward the earth, by the strong updraft of air in the convection current. Accompanying the tearing asunder of the rain drops is the production of positive and negative ions. The finer drops, usually associated with negative ions, are carried back into the cloud layer, while the heavier positively charged drops either continue to earth or, like the minute drops are carried back to the cloud layer. The positive and negative charges respectively accumulate in different parts of a cloud creating excess charges at different points, as for example, an excess of positive charges in the cloud base and an excess of negative charges in the cloud top, thereby producing an unstable electrical condition, Fig. 5. Discharges follow which momentarily at least, return that particular part of the atmosphere to a state of equilibrium. The discharge is called lightning. Some discharges are effective between a cloud and the earth or between the invisible cloud tops.

Static without Thunderstorms Are these discharges the cause of static and is the thunderstorm a pre-requisite to static? The answer to this query must be negative, judging from a study of the relation between Lows and poor reception in the northern part of the United States during the months of January, February and March, 1926. In passing, we should note, that thunderstorms are always associated with Lows, occuring most frequently in the southeast quadrant; however, all Lows are not characterized by thunderstorms. It appears that the building up of the electrical charges in the upper air, in a manner which creates a large difference in potential between the atmosphere and the earth's surface or between any two clouds or parts of clouds, constitutes the basic factor in producing static. No doubt, as rapidly as these charges are gathered, discharges occur, many of which are so small as to be inaudible at the earth and the spark in the discharge path invisible. Normally we would not construe such action as a thunderstorm because at the earth people would be unconscious of its existence. We should therefore think of a thunderstorm not as the cause of static but as an index of what is happening in the upper atmosphere.

The conditions indicated above relating to the formation of thunderstorms, included convection as one requirement. This factor can not be overemphasized, for convection may be so strong, even in the absence of high temperatures, as to strongly ionize the atmosphere. The distribution of the charges may however be such as not to result in discharges of the same magnitude as in a thunderstorm. In other words, a strong updraft of moisture-laden air under conditions which allow of condensation of the moisture and subsequent disruption of the rain drops will develop an electrical potential as disturbing as that induced by the thunderstorm. Consequently, in the absence of the thunderstorm and even in cold weather, if convection accompanied by a humid atmosphere is strong, that is, if the pressure reading in the center of a wet Low is very low, perhaps 29.4″ or less, radio reception may be as much interrupted by static as when thunderstorms are widespread. Conditions similar to these often existed in the eastern part of the country during the first three months of 1926 and were apparently largely responsible for the difficulties in reception experienced by so many listeners.

In winter, when condensation in the upper air results in the formation of snow, the mechanics are identical with those when rain forms, but fewer charges accumulate due either to weaker convection aloft, or, to the oversize snow crystal occurring less frequently than the oversize water drops or being less susceptible to breakage because of its slight resistance to the air.

Summary of the Relationships From this brief discussion of the relation of the thunderstorms to static we should reach the following conclusions:—

(1) Thunderstorms do not cause static but are an index of conditions favorable for static. static.

(2) Thunderstorms are not a pre-requisite to static.

(3) Static conditions are merely an indication of a state of unstable electrical equilibrium in the atmosphere.

(4) Ionization of the atmosphere may be accomplished as readily by intense humid Lows at low temperatures as those less well developed at high temperatures.

(5) Owing to the less favorable conditions for the breaking up of snow crystals than of rain drops, static is normally much less common in winter than in summer.

To these conclusions we may append the statement that these assertions do not apply to short wave lengths such as 40 meters or less; since they seem not to be seriously disturbed by thunderstorms. Furthermore, we must not assume that the ionization of the atmosphere is due solely to the convection circulation. Other influences such as the earth's magnetism or solar radiation may have equal or greater importance.

With the characteristics of the pressure areas before us and of the thunderstorm's relation to static we may now consider the larger aspects of the fascinating field of weather forecasting.

MAJOR FACTORS IN WEATHER FORECASTING

V

Verification of Forecasts A part of the forecast issued at Boston on the weather map Fig. 1 was:—

"Fair and continued cold tonight."

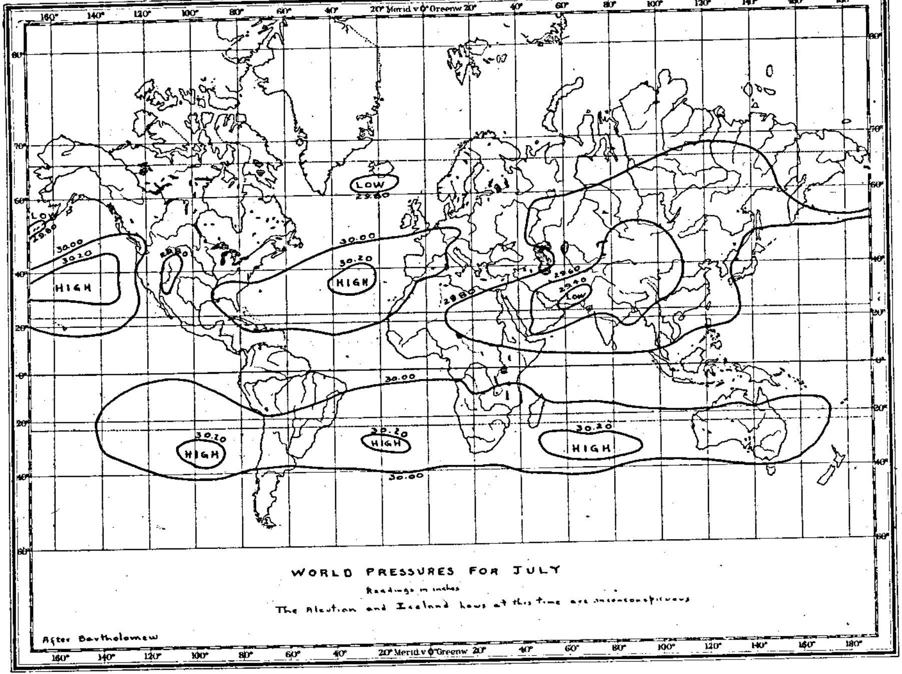
The map for the next morning, Fig. 2, shows a verification of this forecast, the skies continuing clear and the isotherm of 10°F. still in close proximity to the city.

As everyone knows, all forecasts do not attain one hundred per cent accuracy but nevertheless the accuracy is much higher than is popularly appreciated. When the weather forecast proves wrong we note the error and remember it a long time, especially if we have made plans dependent upon it; but when the forecast is verified we usually give the matter little further thought because then the normal thing has happened and the normal is rarely impressive.

Value of Extensive Observations Many perplexing problems beset the way of the weather forecaster as the reader by this time may well suspect. The Lows and Highs do not always behave as we anticipate. In the absence, for example of simple quantitative measurements bearing on the rate of storm movement, difficulty arises in determining the exact mileage of a given storm area in the next 12 to 36 hours. Again, we can not always be certain whether a storm will continue due east or perhaps shift to the northeast or southeast. Furthermore, local phenomena such as large lakes, especially the Great Lakes, or mountains, affect not only the progress of the pressure centers but also the amount of moisture which they may evaporate or precipitate. Then, as a climax to all of the forecaster's troubles, is the lack of daily observations in far northern Canada in the region of Hudson Bay and over many parts of the Atlantic. We are confident that these observations would afford considerable aid to the forecaster. This we know, because ships' meteorological records made off the Atlantic coast and occasional observations from central Canada received at the Washington office of the Weather Bureau several days after certain forecasts have failed, bring to light the reason for the failure, and show conclusively that had the data been available at the time of forecasting, an entirely different forecast would have been issued and would have proved correct. In spite of all these difficulties it is gratifying to observe the progress in our forecasting; to know that our Weather Bureau maintains a forecast efficiency on the average of close to 85 per cent. In the transition seasons the accuracy declines at times to as low as 50 per cent, while in mid-seasons it rises to over 90 per cent.

Permanent Pressure Centers

For those who wish to have a fairly broad view of the factors entering into weather variability, consideration of the place of our local Lows and Highs in the general atmospheric



WORLD PRESSURES FOR JULY
Readings in inches
The Aleutian and Iceland lows at this time are inconspicuous
After Bartholomew
20° Merid v 0 Greenw 20°
HIGH
LOW
30.00
30.20
29.80
29.60
29.40

Fig. 6

circulation is essential. In intermediate latitudes or our so-called temperate zone, the map reveals certain great permanent and semi-permanent Lows and Highs. Over the Pacific Ocean is a couplet, Fig. 6, consisting of a high pressure area in the vicinity of the Hawaiian Islands called the Hawaiian High and a low pressure center over the Aleutian Islands named the Aleutian Low. Similarly over the Atlantic Ocean in the vicinity of the Azores Islands is a high pressure area called the Azores High and a low pressure near Iceland termed the Iceland Low. All of these pressure areas are permanent, modified only in intensity during the year, the Lows more pronounced in winter than in summer and conversely in the case of the Highs, Figs. 6 and 7. Over Asia occur the semi-permanent pressure centers, that is, a high pressure in winter which shifts to low pressure in summer. Rapid radiation of heat in winter from the vast continental surface results in the accumulation of cold air and consequently the building up of high pressure. Excessive heating in summer as the days increase in length causes an expansion of the air over the continent and the development of low pressure. These semi-permanent pressure centers so far as we now know, do not affect the weather in the United States and therefore may be eliminated here from further consideration.

Reverting to the permanent pressure areas over the Pacific and Atlantic Oceans, we find that changes in pressure in the respective couplets correspond. Again, there seems to be a definite relation between the intensity of their development and the passage of the local Lows and Highs

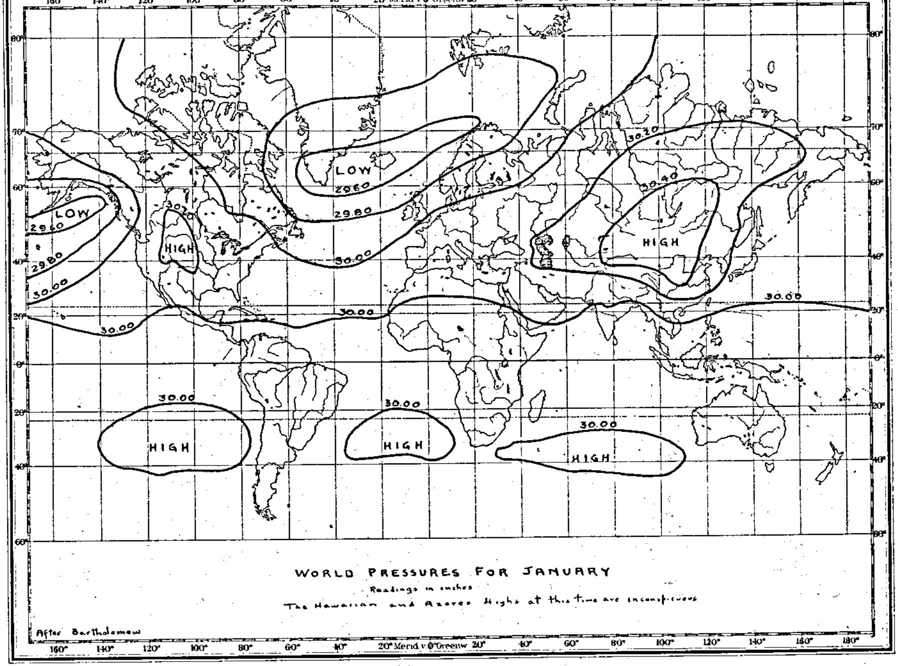

WORLD PRESSURES FOR JANUARY
Readings in inches
The Hawaiian and Azores Highs at this time are inconspicuous
After Bartholomew
LOW
HIGH
29.60
29.80
30.00
30.20
30.40
20° Merid. v. 0° Greenw.

Fig 7.

across Canada and the United States. Some of our forecasters, recognizing this close correlation have said that if they could have daily details of the distribution of pressure in these centers, it would beunnecessary to have much of the detailed pressure information for the land which now appears on our weather map. In other word, they assign the major causes for our daily weather to the general atmospheric circulation and not to local phenomena.

Shifting Ocean Currents Meteorologists recently have been impressed by a possible influence of shifting warm and cold ocean currents upon the great permanent Lows and Highs, which in turn would affect the variability in the passage of Lows and Highs across the United States. We know, for example, that the Gulf Stream does not remain fixed in position but some years is nearer our Atlantic Coast than in other years. This may mean an accumulation of warm moist air of such proportions to create a marked reduction in pressure over the ocean and consequently an indraft of cold air from the Artic regions southward across northern United States. Such an air movement would derange the pressure distribution over the country and in many ways influence the storm paths, rate of storm movement and the local weather. Herein lies a possible explanation for the unusual difficulty which radio listeners had during the winter of 1925-26. There was an exceptional amount of static in the northern part of the country and many broadcasting stations heretofore easily heard, either lost their great range or could not be heard without the interference of static.

The unusually cold stormy weather in northeastern Europe in late 1925 may likewise have been due to the shifting of ocean currents in the North Atlantic and consequent realignment of pressure centers. Similarly, eastern Asiatic weather would be affected by shifts in the Japan Current and the flow of air in the Aleutian Low and Hawaiian High.

Solar Radiation The problem of forecasting grows still more complex. Not only must the general circulation of the atmosphere and the effect of ocean currents and temperatures be considered, but behind these factors may lie fluctuations in the receipt of heat from the sun. In fact, the Smithsonian Institution and the National Geographic Society jointly, are financing a series of observations to be extended over a period of five years to determine the influence of the sun upon our weather. Mr. H. H. Clayton, until recently associated with the Argentine Weather Bureau, made successful forecasts in Argentina, based upon variations in solar radiations, and largely due to his work, the institutions named are supporting further investigations along these lines. It is the belief of a number of meteorologists that solar radiation affects our entire system of winds. The weather map published daily at Washington, D.C. prints the solar constant of radiation.

For radio enthusiasts and others interested in the weather, these studies suggest an opportunity to help in shedding more light upon the behaviour of the atmosphere. Through a knowledge of the variability in radio reception under different weather conditions, we may find a way toward an improved understanding of the circulation of the atmosphere and particularly the place of the passing Lows and Highs in the whole atmospheric scheme. Should we solve this problem, we may look forward not only to increased accuracy in daily forecasting but to the possibility of accurate long range forecasts.

Here then, as stated at the outset, is an opportunity to accomplish two purposes: on the one hand to help us determine how to transmit radio messages under any weather conditions and on the other hand to determine the exact nature of the atmospheric circulation that we may be able to improve the accuracy of both short and long range forecasts.

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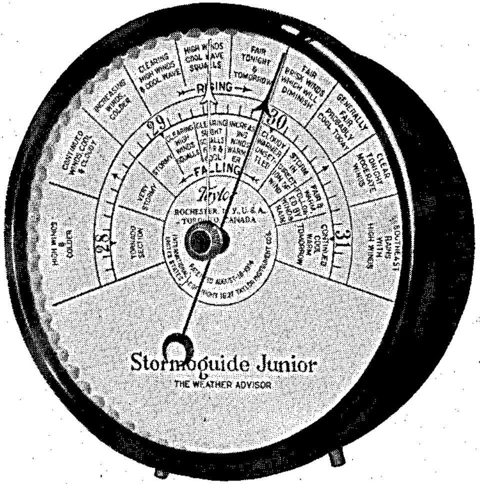

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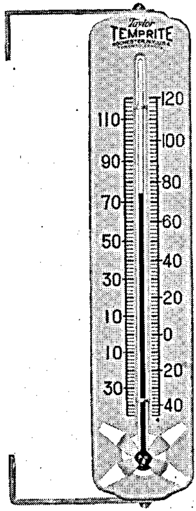

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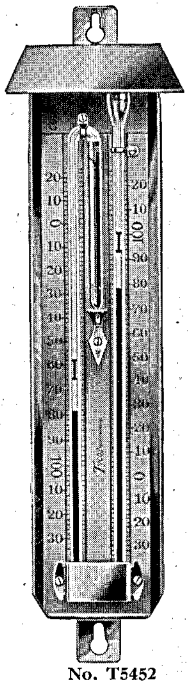

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HELPFUL BOOKS AND MAPS

These books do not represent an exhaustive list, but they have been carefully selected with reference to the fields of Climatology and Meteorology as a whole and with regard to the varying interests of the readers of this pamphlet. The space limits in the preceding pages do not permit of an exhaustive treatment of the various subjects discussed. For those whose interest is sufficiently aroused to cause them to wish to know more on the subject, the literature listed here will serve effectively.

The books are grouped for convenience, according to their subject matter and so far as possible in each group with respect to their simplicity of treatment of subject matter, from simple to complex.

METEOROLOGY

Why the Weather? C. F. Brooks, Harcourt Brace & Co.—N. Y. 1924, 310 pp.

Meteorology, C. F. Talman, P. F. Collier & Son Co.—N. Y. 1922, 384 pp.

Meteorology, W. I. Milham, The Macmillan Co.—N. Y. 1912, 549 pp.

Meteorology, A. E. M. Geddes, Blackie & Son, Ltd. London, 1921, 390 pp.

Physics of the Air, W. J. Humphreys, Franklin Inst., Phil. 1920, 665 pp.

CLIMATIC CHANGES

Earth and Sun, Ellsworth Huntington, Yale Univ. Press—New Haven, 1923, 296 pp.

World Weather, H. H. Clayton, The Macmillan Co.—N. Y. 1923, 393 pp.

CLIMATOLOGY

The Climates of the United States, R. DeC. Ward, Ginn & Co., Boston, 1925, 528 pp.

The Climates of the Continents, W. G. Kendrew, Oxford Univ. Press, Oxford, England, 1922, 387 pp.

Handbook of Climatology, J. Hann, translated by R. DeC. Ward, the Macmillan Co.—N. Y., 1904. 437 pp.

MAPS FOR STUDIES IN METEOROLOGY AND CLIMATOLOGY

Atlas of Meteorology, J. G. Bartholomew, Edinburgh Geog. Institute, Edinburgh, 1899.

Daily Weather Map, U. S. Weather Bureau, Washington, D. C. and about 65 other Weather Bureau stations.