



Royal Meteorological Society

THE PUBLIC WEATHER SERVICE
PROGRAM at CHICAGO

by
Gordon E. Dunn

CANADIAN
BRANCH

25¢

Published By

ROYAL METEOROLOGICAL SOCIETY, CANADIAN BRANCH

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by

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Presented at the regular monthly meeting of
the Royal Meteorological Society, Canadian
Branch, held in Toronto, March 29, 1951.

THE PUBLIC SERVICE PROGRAM AT CHICAGO

The Chicago Weather Bureau Office is charged with the responsibility for the preparation and distribution of district forecasts for Minnesota, Iowa, Wisconsin, Michigan, Illinois and Indiana, fire weather forecasts for about this same area plus Ohio, marine forecasts and warnings for all the Great Lakes, quantitative precipitation forecasts for even a larger area and all the local service requirements of a metropolitan area of approximately 5,000,000 people in Chicago and vicinity, which is both the transportation hub and the agricultural center of the U.S.

Recorded Forecast

One means which we have in Chicago of ameliorating the office workload is through the recorded type of weather forecast in co-operation with the telephone company, i.e., WEA 1212. As you no doubt know the telephone company in many of the larger cities has a number which you may call to obtain the time and in some cities another number which may be used to obtain the weather forecast. In Chicago the telephone company is furnished hourly by teletype the current temperature, the relative humidity, the wind direction and velocity and the weather forecast for Chicago and vicinity, and this information is recorded on a tape. At the telephone company a special switchboard with 250 trunklines handles the calls to WEA 1212 automatically. Usually the record is played twice each minute but is shortened sufficiently in bad weather so that it may be played four times per minute, so it is theoretically possible that 1000 calls may be handled in one minute. Actually of course this will not be the case since many of the callers will be plugged in in the middle of the record and they will listen through the remainder of the forecast and then through a complete recording. Our daily average excluding Sunday, during the past two years, has increased from about 38,000 to 48,000 and on January 28 and 29 this year the totals were 292,000 and 290,000 plus for each 24-hour period respectively. This together with the broadcast by a number of radio stations of the same information every hour on the hour has reduced the so-called 'curiosity' calls to the weather office to less than 2% of the total calls. By curiosity calls we mean such calls as "What is the temperature?", and even such requests as "What's the forecast for Chicago?".

On the average 800 to 1000 telephone calls per day are received in the several units of the Chicago Weather Bureau excluding the briefing unit at the airport. During the days of severe weather the number of calls between 9 and noon is limited only by the number of trunk lines into our switchboard which is 6 plus 2 unlisted numbers. Approximately 98% of these calls are for more detailed weather information than is available in the local forecast. During the winter we may expect on Fridays about 35 calls requesting an automobile trip forecast to Miami, Florida, and perhaps a hundred altogether to all sections of the U.S.

Local Service Calls

About 25% of the phone calls coming into the office are from business, industry and, during the growing season, agricultural interests. From November 1st to March 31st we issue a "Nationwide Shipper's Bulletin". In this bulletin the U.S. is divided into 25 zones and maximum and minimum temperatures are forecast for each zone for each of the next 3 days. These temperatures are the highest and lowest which a shipment going through a particular zone by the principal railroad or trucking routes will encounter and against which perishables should be protected. This bulletin is given to Western Union and anyone may subscribe to it by paying the communications charge of \$10.00 per month. Railroads and others in the shipping and trucking business are the principal users of this bulletin. Some railroads obtain the forecast in Chicago and transmit it over their own communications system to the major shipping points in their system. Railroads use this information for a number of other purposes. When the temperature falls to 20 degrees or lower, the length of trains is shortened. More "hot-boxes" develop in cold weather due to stiff lubricants and increased friction, and consequently maintenance problems increase.

But there are many business concerns with only occasional shipments of perishables who call us with the request: "I am sending a shipment to New York, and it will arrive in 4 days. What should I protect against?" We give them a figure which represents our estimated low with an additional margin of safety. There are about 150 business concerns that call us more or less regularly for weather information. Milk, for example, is that type of commodity which must be received and bottled one day and delivered the next. In severe weather the production man in the milk business is really under pressure and needs all the help he can get from the weather man. Consumption of milk and ice cream varies directly with the temperature. Consumption of cream for coffee varies inversely with the temperature. With sleet or heavy snow, farmers don't show up at the milk factory, the milk trucks are 6 to 10 hours late getting into Chicago from Wisconsin and the city's milk supply is affected. In such cases surplus milk is kept over instead of turned into cheese and other by-products. But the milk distributor must have adequate and timely warning.

Meat consumption varies inversely with the temperature. Meat packers are concerned not only with icing but, in certain cases, with preheating, lest meat arrive at its destination frozen so solidly that its distribution is delayed. In shipping livestock, the depth of bedding provided and the amount of heavy paper or canvas tacked to the sides depends on the weather. If a cold wind blows in on one side of a car of hogs, for example, they may pile up 10 deep on the other side and the bottom layer suffocates. Or a truckload of hogs may perish on the road if the truck becomes stalled in snow drifts in zero weather.

Makers of candy and chocolate-covered cookies must avoid shipping into areas where the temperature is 87 degrees or higher. Bakeries

want 36-48 hour forecasts in order to avoid over-producing today what must be sold fresh tomorrow. In bad weather housewives may do without, or do their own baking, or more likely call their husbands to pick up some bread and cake at the downtown stores. In such situations a larger supply of bakery items must be located downtown rather than the usual concentration in the suburban areas. One New York bakery estimates savings of \$250,000 a year by using weather information and having its goods in the right area at the right time.

Carload shipments of sand, gravel, coal, iron ore, bauxite, etc. are usually exposed to the weather and can freeze so hard that unloading is delayed and cars tied up. So the Chicago forecasters find themselves involved with iron ore and onions, bananas and cosmetics, liquid wax and lettuce, canneries and fruit-spray, sports and construction, heating and ventilating, and so on and on, to mention only a few. All want advice more or less in terms of their particular operations and thus the forecaster must be familiar with their problems.

Service For Electrical Utilities

Service to various segments of industry has been discussed in very general terms. Now we might take the electrical utilities and discuss in some detail the service provided them. The consumption of electrical energy varies from day to day because of a number of factors. Maximum consumption occurs normally on Tuesday when the ladies wash on Tuesday and iron on Wednesday. And there are other strictly meteorological factors which the load-dispatcher must use in his operational equations. The total power consumption in kilowatts varies approximately 10% from clear bright days to dark days with thick low clouds. Temperature is another weather factor and power consumption due to the temperature factor reaches a minimum point at 60°F. During the summer it increases about 8% as the temperature climbs to 100° and in winter increases about 10% as the temperature falls to zero. Electricity must be available the instant it is needed; it cannot be stored for emergencies. Therefore the timing of significant changes in the weather is of great importance to the load-dispatcher in meeting peak load requirements. Excess electrical energy is wasted while an inadequate supply will cause a serious dislocation in the activities of a large city; delicate electronic machines will function improperly, elevators will fail to reach the top floors in the skyscrapers, etc.

Forecasts are prepared for the electrical utilities in northern Illinois and surrounding areas at 3 a.m., 10 a.m. and 3 p.m. for the following 6 hours and at 3 p.m. for the period through the following day, in addition. These forecasts include the temperature range, cloud ceilings and thicknesses, hydrometeors, visibility, wind direction and velocity and the light factor.

A light factor table has been devised ranging from 10, a value where illumination, although not perfect, is such that it causes no increased demand for electrical energy, to zero, which is almost total

darkness. Early statistical research indicated that the principal variation was caused by cloud thicknesses and ceilings when ceilings were below 10,000 feet. A diagram (Figure 1) was derived which gives the light factor by plotting ceiling height against cloud thickness. In the late fall, winter and early spring the passage of a cold front with low clouds in Chicago may

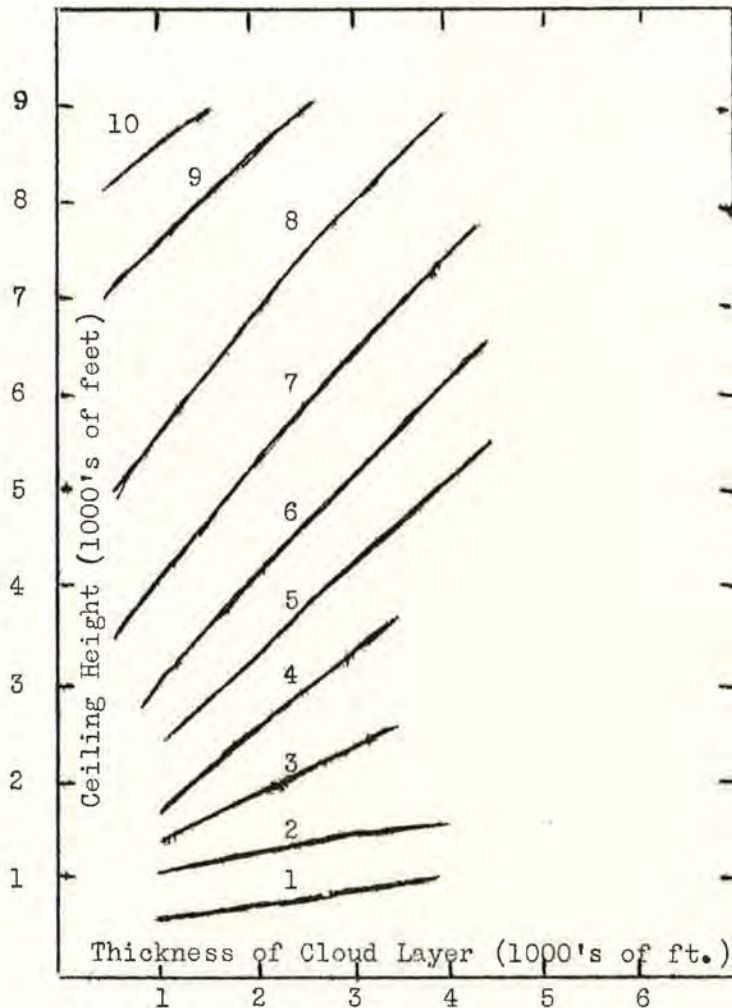


Figure 1

be accompanied by almost total darkness in the loop as the large accumulation of smoke from manufacturing and heating plants is banked along the front by an easterly wind on one side and a north-westerly wind on the other. Two hours notice of such an occurrence is sufficient for the utilities to have ample electric energy available.

Prior to the last few months there had been no instrument which would satisfactorily measure the light factor. While this may have been a happy state of affairs for the forecaster, it decidedly limited the improvement of illumination forecasts. The Commonwealth Edison Company has finally been able to design an illuminometer which will record daylight intensity in foot-candles. This instrument uses a photo-electric cell sensitive in the visual light range. The photo-electric cell is mounted within a sphere and faces downward. The top half of the sphere is opal glass frosted on the in-

side. The bottom half of the sphere is opaque but is painted white on the inside surface. Current through the photo cell is amplified through a potentiometer and the readings recorded. Readings are taken at 3 locations in the city and an average value obtained. Under the most favorable conditions values as high as 10,000 foot-candles may be obtained but only the range from 0 to 4,000 foot-candles appears to affect electrical consumption and is of interest to the load dispatcher. At the present time statistical studies are in progress to correlate cloud height, cloud thickness and visibility with the number of foot-candles recorded during daylight hours. For example, fair to partly cloudy skies, with visibility 5 miles or better average around

4,000 foot candles; thin, broken to overcast clouds approximately 2,500 foot candles and low dense clouds 25 to 75 foot candles.

It is planned to begin furnishing the electric utilities with the light factor in foot candles early in April and for the first time actual verification of the light intensity forecasts will be possible.

Weather information is used in other ways by the electrical utilities. The damage which may be caused by the accumulation of ice on wires is well known. In contrast to the telephone companies, the electric utilities can take preventive action, if warned of the extent and duration of the glazing condition, by increasing the voltage sufficient to heat the wire and melt the ice. They like to have advance information of favorable weather conditions over week-ends when the load is low so that equipment may be taken out of service for repair and maintenance. Between June 15 and September 1 the majority of our thunderstorms occur at night. Ordinarily the Chicago electrical utility will have about 6 men on duty at night for emergency repair work but if a thunderstorm is expected they will have as many as 45 men at strategic locations throughout the city to repair damage from lightning strikes and squally winds.

The Private Meteorologist

In contrast to most other countries, a private field in meteorology has developed in the U.S. During the last war approximately 20,000 weather officers were given professional training by the armed services and some wished to utilize this training in private life after demobilization. During the war many concerns learned to use weather information advantageously in their business and in large metropolitan areas requests for specialized weather service began to exceed Weather Bureau facilities.

Up to a point the private meteorologist works in the same manner as a meteorologist in the Weather Bureau. He is licensed for a drop on the national teletype weather circuits, receives most of the weather observations and forecasts on these circuits, plots weather maps and makes either original or adapted forecasts or both. But at this point his work diverges sharply from that of the Weather Bureau. Where the Weather Bureau serves the general public and large group interests with its local and area forecasts, the private meteorologist serves the individual weather informational needs of each of several industrial clients. It is not within the physical capacities of the Weather Bureau to give personalized service to every private organization. Nor can the Weather Bureau keep constant watch over individual industrial needs and initiate timely personal advices in every case. As a rule of thumb we resist service requests which regularly require more than five minutes per day for any individual business. In addition to operational forecasts, the private meteorologist may undertake climatological surveys, agricultural weather estimates, studies to determine the best site for airports or industrial plants, studies on smoke and air pollution and many other types of research service important in the field of commerce and industry. Many business concerns now employ a company

meteorologist and in some instances his meteorological duties may be combined with other activities in which weather is an important factor, such as meteorologist and dispatcher for airlines.

Because of the large amount of work involved in the preparation of television weather programs, this field has been left largely to the private meteorologist. The latter agrees, in the license under which he gains access to the national weather teletype circuits, to use the official weather forecast. In Chicago there are now weather telecasts on all four television stations. Station A has probably the most popular weather telecaster in the country. He comes to our office and is briefed by the forecaster on the background for the Chicago forecast. He has access to all our charts, weather summaries and other information. He gives credit to the Weather Bureau for the source of his material and has the highest personal ethics in that, when the forecast is in error, he does not try to get out from under by blaming the Weather Bureau.

Station B uses script written by a private meteorologist telecast by a non-meteorologist. From the standpoint of the professional meteorologist this telecast packs more information and may be better, but from the standpoint of the general public is often a little too technical. Also occasionally the private meteorologist is unable to resist taking a last glance at the teletype sequences and changing the forecast a little now and then, which means differing forecasts are being disseminated to the general public.

Station C pipes their program in from New York. It is not too bad although generally considered inferior to the two programs previously mentioned. At the conclusion space is left for the latest local forecast. Considerable difficulty has been experienced in persuading the local station to use the latest forecast. Frequently the station has used a forecast 18 hours or more old and at other times the stenographer calls just before she goes off duty and apparently takes down only what she wishes.

Station D has a program by a meteorologist without access to any teletype circuits, and apparently relies on the newspapers and radio broadcasts for his weather information. On the basis of these meager data he issues weekly, monthly and seasonal forecasts.

One of the above stations has a short weather program developed in this way: an entertainer calls up, asks where the fronts or the lows are, writes down the Chicago and vicinity forecast and goes on the air with a weather program. As can be seen, a chaotic and undesirable situation is arising in regard to the weather television programs in Chicago, which promises to become worse as time goes on. It can only be corrected, it is believed, by some form of control by the Weather Bureau.

Radio Broadcasts

We have been making direct weather radio broadcasts from the Chicago Weather Bureau for about 11 years, except during the war. While the public now takes these broadcasts as a matter of course we still receive about two letters a week from the general public. Although our principal broadcasts are on farm programs between 5:30 and 6 a.m. we have, during the last five years, received approximately 100 letters from city listeners saying something like this: "We set our alarm clock for 5:45 a.m. so we can always wake up and hear your weather broadcast". A few weeks ago the WLS station manager in his weekly broadcast stated that a number of listeners had written in asking for a Saturday evening broadcast and he wondered what others thought about it. Within a week he received several thousand letters asking for it and only six saying they preferred the time be given to some other program. In Chicago radio circles this is considered a "strong" listener response. Local and/or state forecasts are broadcast over almost all the 15 or more Chicago stations every 15 minutes or so between 6 and 8 a.m. We do not try to duplicate this. Many of our letters contain some sort of a request for additional weather information--a detailed forecast for their locality, the temperature at Fort Wayne, the weather in Florida, Texas or some other place where they may have property or friends, but the request received more frequently than any other is: "Describe the weather chart" or "Landscape the weather map for us". We think the reason for this is that almost everyone is an amateur weather forecaster of one sort or another and he wants either to know the basis for the forecast he hears or wants to outguess us or both. In any case a sympathetic bond becomes established between the listener and the forecaster, something quite helpful in this imperfect science of ours.

Our script is divided into three separate sections: (1) the newsworthy weather over North America, (2) a description of the weather chart, tying it in with the newsworthy items in the previous section and (3) the weather forecast in very general terms for the area where most of our listening audience is located. Letters are received from such distant points as Long Island, New York, Texas, Nebraska, Montana and a few points in Canada. During the summer as our early morning broadcasts move from darkness to daylight the area where we may be heard contracts somewhat.

Requests for one-minute weather broadcasts are resisted although it is ~~politic~~ for us to make a few. One minute will little more than permit the reading of the local forecast which the station announcer can do better than the forecaster.

Verification

Verification is a rather touchy subject on the U.S. side of the border and possibly this may also be true here. It seems to me that first the Weather Service must decide what is the primary purpose of the program. It may be:

1. A determination whether satisfactory forecasting standards are being maintained.

2. Determination of individual forecasting skill.
3. Use in some practice forecast program.
4. Have some figures available when requests for forecast verification arrive from the legislature, critics or the public.

Any verification system should be rational, fair to the forecaster and not require more than a few minutes of his time in paper work. If too many elements are verified, too much smoothing will result and the final values will have little significance. Except for very short term forecasts, spot check verification, e.g., verification of specific elements at exactly 0200, 0400, 0600, etc., should be avoided since after eight hours the variability or intermittency of clouds and weather is such that little or no difference appears between mediocre and excellent forecasters. Medium term forecasts (24-48 hours) should not be verified by methods involving a refinement of detail beyond the present state of the science. Verification of trivia should be avoided. The treatment of traces has always been a problem. In period after period in winter, especially around the Great Lakes, it is almost fortuitous whether the observer records a trace or .01" from the frequent snow flurries. Certainly the forecaster should not be penalized the same for missing a snow flurry and missing one inch or more of rain.

In Chicago a verification form is used which provides, usually, for four verification points in each state or forecast area. From the forenoon forecast, which covers tonight and tomorrow, the forecaster transcribes the forecast for the first 12-hour period ending at 0630C and the second ending at 1830C into precipitation or no precipitation and warmer, colder or stationary forecasts, and the forecasts are verified on this basis. The stationary temperature limits vary with the season, 6° in summer, 8° in spring and fall and 10° in winter. It is our experience that this system will indicate differences in the degree of skill of forecasters and will provide a verification figure which is acceptable to the public.

Forecast Improvement Program

Last fall the U.S. Weather Bureau authorized a forecast improvement project which the Chicago Forecast Center feels has proved and will continue for some time to prove quite fruitful. Coinciding with the fall quarter at the Institute of Meteorology, University of Chicago, Dr. Herbert Riehl presented a series of lectures that described and evaluated approaches to forecasting--empirical, kinematical, dynamical--and forecast techniques developed in Norway, Germany, Britain, and the U.S. Following the lecture each week day morning the group tried to apply what appeared best in the old and in the new to the current weather situation. Prognostic 500 mb and sea-level charts were drawn for 24 and 48 hours in advance and weather forecasts for 10 stations in the Chicago district were made. A map discussion, held jointly with the official forecaster, followed. Six Weather Bureau forecasters, including four from the Chicago staff, participated together with some graduate students from the University. In the afternoon the Weather Bureau group surveyed the literature of the last

20 years with the idea of beginning the preparation of a forecast manual. Obviously it was impossible to cover the whole forecast problem in the time available so the group's efforts were largely concentrated on the central problem of predicting the development, changes in intensity and movement of temperate zone cyclones. Dr. Riehl has been rewriting and editing the material for several months and some preliminary copies will be available shortly.

To date the subject of forecasting is too vague to permit the introduction of rigid engineering techniques, but an effort was made to develop work-sheets which, at least, would insure that all the important factors, such as deepening, bearing on a particular phase of a forecast problem receive consideration. It is worth stressing that the development of these work-sheets represents an attempt to initiate a change from qualitative to quantitative forecasting, which is the trend, it is believed the future must necessarily follow. It is hoped that after a while these forms will provide data and experience which will assist in the development of more exact procedures. At least they will give us an evaluation of the factors which, currently, are believed favorable or unfavorable for certain meteorological developments.

So far a check-sheet has been developed on "Changes in Intensification of Lows and Pressure Fall Centers" and another is in process of development on "Formation". So far the preparation of an accurate 500-mb chart, or one at some other steering level, seems to be a prerequisite for any reliable procedure for calculating direction and movement of cyclones and apparently even this is not the complete answer.

In conclusion it should also be stated that techniques for translating even the most perfect prognostic chart into the actual weather are almost non-existent and the attention of meteorological research is invited to the vacuum existing here.