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THE USE OF NUMERICAL PROBABILITY FACTORS IN PUBLIC FORECASTS FOR THE PREDICTION OF PRECIPITATION OCCURRENCE[1]

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1. INTRODUCTION

When the Canadian Weather Service re-organized its Public Weather Forecasting System shortly after World War II,one of the features of the new terminology ground rules was the almost total absence of any reference to probability modifiers. The use of such expressions as "likely", "chance of", "risk of", etc., was prohibited except for one or two special cases and the forecaster had no alternative but to express the forecast in categorical terms. This policy was adopted for certain specific reasons, which at the time made sense. Certainly,the indiscriminate use of undefined probability modifiers can seriously reduce the effectiveness of the forecast, and there was substantial evidence that this had been one of the problems with the Canadian Public Forecasts prior to 1946. Perhaps another reason was the general climate of optimism regarding the solution of the forecast problem. This was partly a result of the impetus given to meteorology by the aviation requirements of World War II. Since categorical twelve hour Aviation Forecasts were being prepared in such specific terms as time changes of ceiling, visibility, weather, etc., etc., why not categorical 36-hour Public Forecasts with a much reduced number of parameters? Of course, the fundamental difficulty was the rapid decrease in predictability of the atmosphere during the 24- to 48-hour period, and in spite of all the advances of recent date, this is still the key problem.

During the past 25 years the advances of the Science have provided us with a much clearer insight regarding the nature of the problem, an insight which has underlined its complexity. The meso-scale phenomenon

1. This is an abridgement of a paper presented at the Third Annual Congress of the CMS, held at the University of Toronto, May 27-29, 1969.

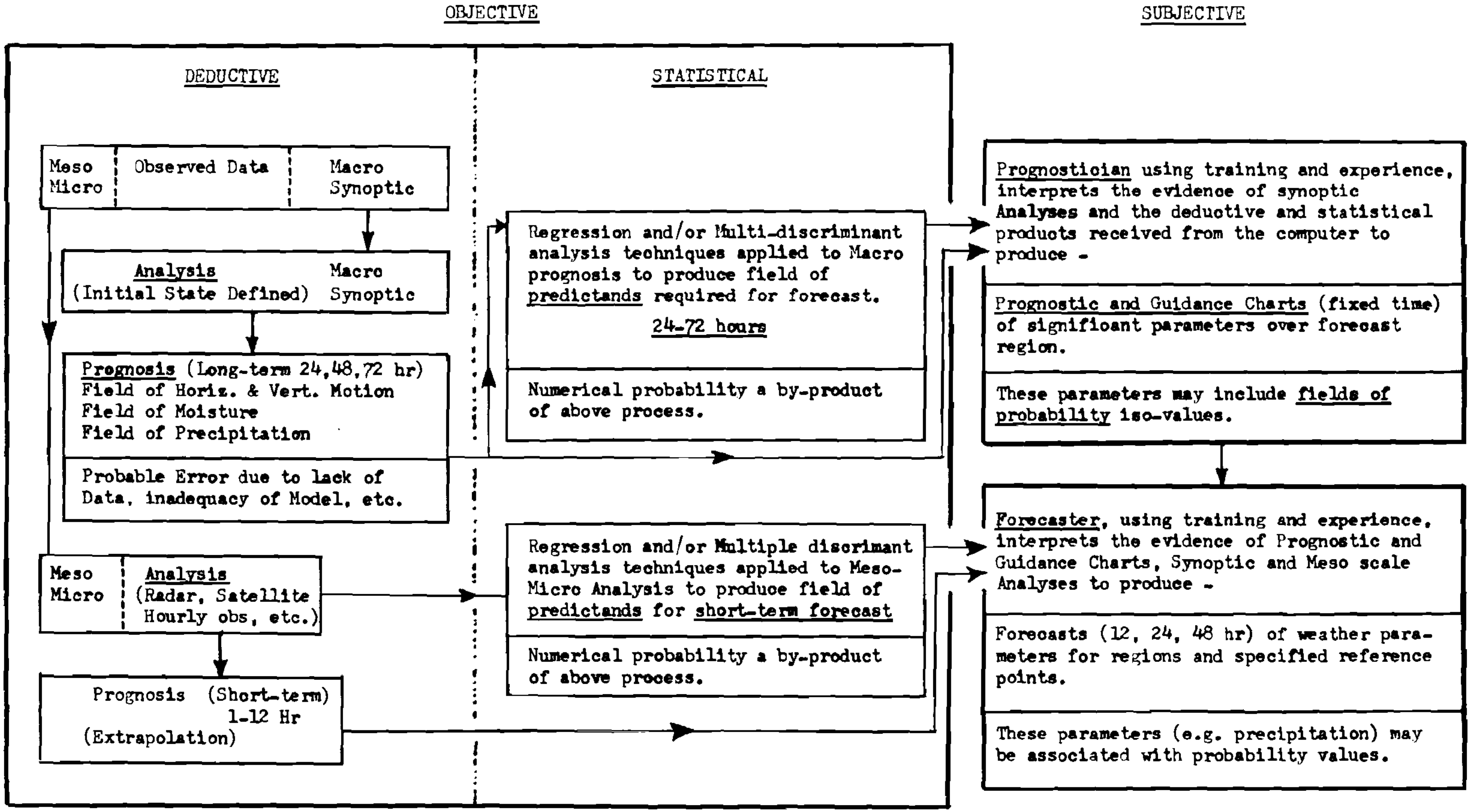


Fig. 1. Processes required to formulate FORECAST and Associated PROBABILITY.

of precipitation which is of obvious interest to the general public has, through the microscope of Weather Radar, turned out to be a far more restless beast than we originally thought, and I think even the most optimistic will agree that the day when categorical forecasts of precipitation can be made with close to 100% reliability, is still many decades away. Perhaps then it is time for us to seriously re-examine the terminology ground rules of our Public Forecasts and to ponder the desirability of introducing conditional or probability modifiers in some form for the purpose of presenting our predictions of precipitation in a more realistic way.

2. REQUIREMENT FOR PROBABILITY FORECASTS IN CANADA

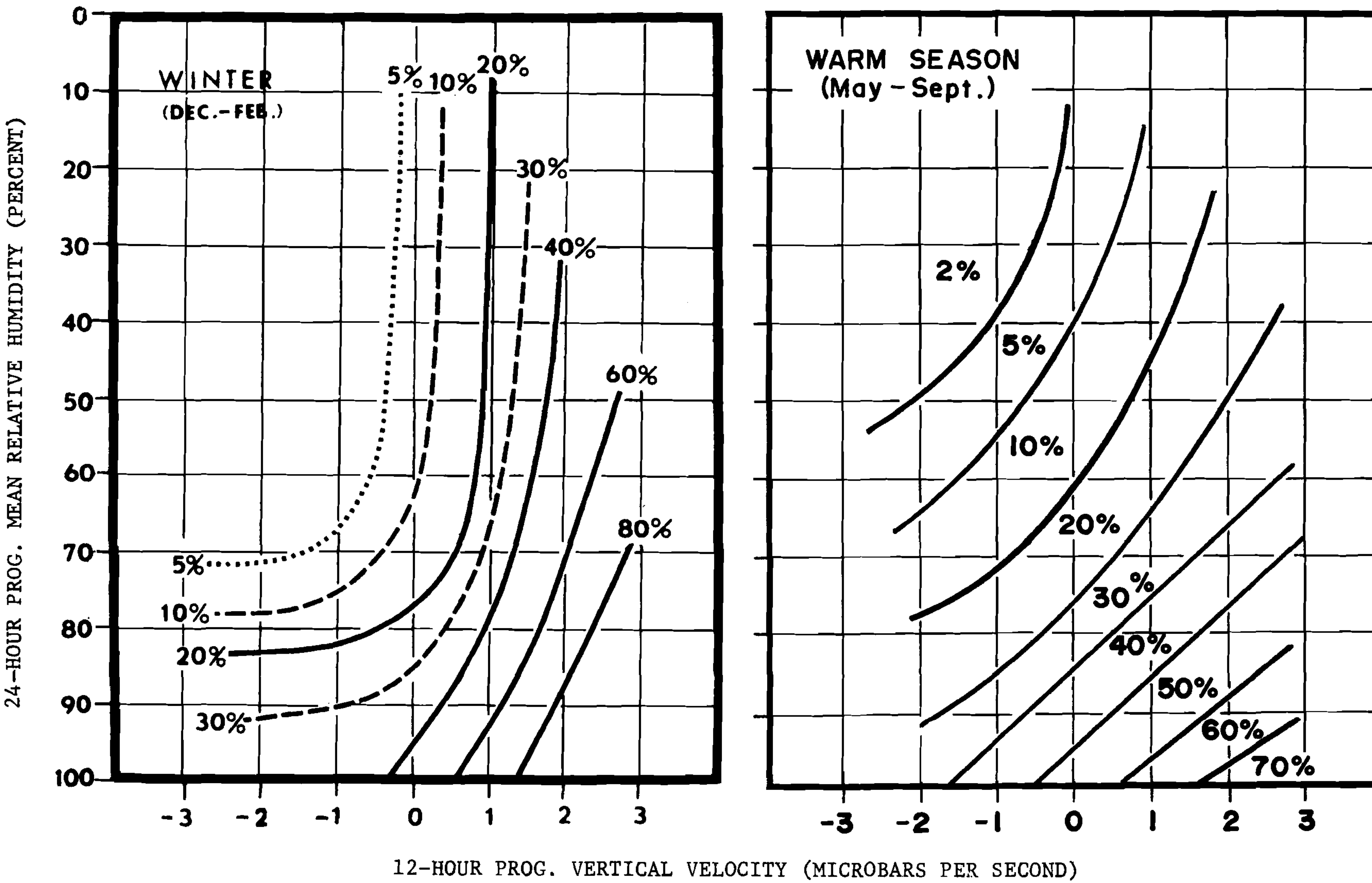
It is impossible to generalize concerning the need in Canada for the use of numerical probabilities in Public Forecasts. The degree of requirement will depend on the sensitivity of the user's activities to weather changes,and the extent to which probabilities will assist him in making beneficial decisions. One sector of the economy which has clearly demonstrated its interest and need, is agriculture. We understand that in Ontario numerical probabilities are now being used in the Special Farm Broadcast advisories issued daily by the Toronto Weather Office during the growing season. In British Columbia the B.C. Federation of Agriculture has made representation for a similar type of advice, and they too have indicated that numerical probabilities would assist the farmer in planning his day-to-day activities.

Probabilities have been used to good effect in Fire Weather Forecasts issued by the Vancouver Weather Office since 1958. They are particularly useful during critical dry spells when it is important for the Fire Protection agencies to get the message regarding precipitation odds, loud and clear. Turner (1959) provides an evaluation of the rain occurrence probability forecasts issued during the 1958 fire season in British Columbia.

With regard to the general public, we have frequently been asked: "When are you going to use probabilities as they do across the border?" Whether this reflects a general need or simply an interest in a new way of doing things, is a matter of opinion. It is perhaps of significance that certain radio stations in the Vancouver area have asked us the same question,and one in particular has expressed its intention of presenting a formal recommendation for introduction of weather forecast probability factors to the next meeting of the Canadian Association of Broadcasters.

Then there are the commercial users including the utilities who must make decisions based on the weather prediction. An illustration of the advantage of numerical probabilities will be seen later in this presentation.

PROBABILITY OF PRECIPITATION (0.01 INCH OR MORE) DURING 12-HOUR PERIOD
ENDING 24 HOURS AFTER INITIAL TIME



Based on vertical motion and mean relative humidity forecast by 6-layer
PE Model for second 12-hour period

Fig. 2(a)

Data: December 1967, January, February, 1968,
13 stations in Central U.S.A.

Fig. 2(b)*

Data: May, 1968, through September, 1968,
13 stations in Central U.S.A.

*** Probability %'s refer to areas between isopleths**

3. FORMULATING AN ESTIMATE OF PROBABILITY

The degree of objectivity, i.e., independence of human judgment, in a probability statement can vary tremendously. The probability of a "deuce" in one throw of a die is 1/6 to all people. The probability of rain in Vancouver next December 15th is 2/3. In both instances the objectivity is total. On the other hand the probability of a disastrous earthquake taking place in California this year will elicit all kinds of estimates, from near-zero to certainty. This is a probability that is based almost entirely on speculation and, therefore, purely subjective.

Somewhere in between these extremes is the degree of objectivity associated with the answer to the question "Will it rain tomorrow?",when addressed to an experienced forecaster backed up by the National Forecasting System. In Fig. 1 we have attempted to present in purely schematic fashion the processes leading to the answer.

The objective processes have been broadly classified as deductive and statistical. The deductive processes are those characterized by a sequential logic of operations which, when applied to the data, produce a unique answer, e.g., the fields resulting from the numerical solution of the Primitive Equations (Prognoses). The statistical processes consist of regression or multiple discriminant analysis techniques which, in this illustration, are designed to apply to the Prognosis for the long-term forecast and to the Data or Meso-Analysis for the short-term forecast. They do not produce a unique answer, but rather a most likely answer with an associated numerical probability. For examples see Figs. 2(a) and 2(b) taken from Hughes (1965). These are designed to provide the forecaster with the probability of precipitation (0.01 inch or more) occurring during a 12-hour period at a specified locality in Central U.S.A., for values of mean relative humidity and vertical velocity predicted by the 6-layer Primitive Equations Model.

The results of the totality of these objective processes, deductive and statistical, are then available to the prognostician and forecaster for guidance, and they constitute the major portion of the evidence on which they will make their decisions. The subjective process now takes over and all the evidence at hand is weighed and evaluated on the basis of training, experience, skill, intra-office consultation and knowledge of certain built-in weaknesses in the computer guidance. Finally, the Weather Prediction is formulated and with it there can be provided a numerical probability arrived at by applying a judgement process to the objectively derived probabilities.

4. DEFINITION OF "PRECIPITATION OCCURRENCE"

First let us examine the problem of a precipitation forecast for a synoptically significant area (say 10,000 square miles), as would be the case with a typical Canadian Weather Service forecast region. The goal is to predict the occurrence of precipitation in time (forecast period), and space (the region). The space factor complicates what is already a difficult task, and to demonstrate this, one has merely to simulate a perfect forecast by describing a sequence of precipitation events which actually did take place. The extraordinary variations in weather caused by such factors, as mountain topography, or proximity of open water, etc., add even more to the complexity of a spatial description.

For this reason we propose for the purpose of this paper to restrict our application of probability factors to precipitation occurrence at a fixed point for a given period of time. This point will be a specified rain gauge at a site considered to be representative of the locality, and the period of time will be one or more of the 12-hour segments of the Public Forecast.

For practical purposes, considering the state of the science, and making an exception of short-range forecasts of from one to three hours, such a point implies a small area, the dimensions of which will depend on the nature of the environment. The area might be in the order of 600 square miles, which would adequately encompass our largest cities.

This might appear to be an excessively large area for application to the environment of a city such as Greater Vancouver, where the precipitation amount for December ranges from 6.44 inches at the Airport to 24.55 inches at Seymour Creek in North Vancouver. Surprisingly, however, the average frequency of occurrence of precipitation at Seymour Creek in December is 18 compared with 19 for the Airport, and since the proposed probability factor relates only to occurrence of precipitation and not to intensity or duration, it would appear that such topographically disparate sites could be included in the same area. Table 1 illustrates the uniformity of precipitation frequency for a large number of such sites both in December and June, in spite of wide dispersion in precipitation amount.

We, therefore, propose to define the precipitation event to which the probability is assigned as follows: A measurable amount of precipitation consisting of a water equivalent of 0.01 inch or more, which occurs at a specified site during a specified portion of the forecast period.

TABLE 1: Frequency Of Precipitation In The Greater Vancouver And Lower Mainland Area Compared With Precipitation Amount.

	Total Precipitation		Number of Days with Precipitation	
	December	June	December	June
Vancouver Airport	6.44	1.84	19	11
Vancouver P.M.O.	9.58	2.56	21	12
Vancouver City Hall	8.04	2.20	19	10
Vancouver Capilano	20.06	4.41	19	11
Vancouver HMCS Discovery	9.95	2.67	22	12
Coquitlam Lake	22.08	5.26	21	13
Burquitlam	10.52	2.92	19	10
Abbotsford	8.18	2.74	22	13
Haney	14.03	4.43	17	9
Ioco	12.94	3.59	18	10
Seymour Creek	24.55	4.63	18	13
Seymour Falls	21.49	4.74	19	12
Steveston	6.15	1.91	19	10
Ladner	5.33	2.29	19	11
White Rock	6.12	2.05	19	9
New Westminister	9.30	2.73	20	10
Chilliwack	9.58	3.00	19	12
Hollyburn	10.16	2.52	18	8
Capilano Intake	20.06	4.41	19	11
Buntzen Lake	17.21	4.46	20	13

This table illustrates the uniformity of frequency of precipitation in the Greater Vancouver and Lower Mainland area,in spite of wide variation in precipitation amount. Period of record - Total Precipitation 1931-60,
- Precipitation Frequency 1941-60,

but a few station records were for periods shorter than these.

5. WHY USE PROBABILITY FACTORS?

There are three main reasons why we believe the use of a probability factor, in conjunction with the prediction of precipitation occurrence, could increase the value of the forecast.

(i) To relate the forecast to the individual and his location.

There are synoptic situations, particularly common in the warmer seasons, where it is difficult to convey to the Public, in conventional terminology, the gradations in risk of precipitation occasioned by the movement of the weather systems across the forecast site.

The public, trying to assess the prospect of rain, hears "Showers today - widely scattered showers tomorrow",and can be forgiven for having difficulty in discerning the difference.

One way to overcome this dilemma would be to provide the forecaster with a means of stating more precisely what he actually knows. If he can express the above situation, as, say:

"60% chance of a shower today
20% chance tomorrow"

he has told the Public a good deal more than is possible with conventional terminology.

(ii) To indicate probability of situations with significant potential.

Another way in which the use of a probability factor could be helpful is perhaps illustrated by the following situation. An organized weather system upstream, has been identified as being characterized by a well-defined precipitation area. Sites in that area are really catching it! The prognosis indicates that a large centre of population will be on the boundary of the precipitation area at some stage of the forecast period. Sometimes an attempt is made to hint at this possibility by using the term "scattered showers", or "scattered snowflurries". These are unfortunate terms, because the City will get either steady precipitation or none at all. The suggestion here is that a probability factor would provide a means of presenting the potential of the situation, e.g. "30% chance of rain (or snow)",and that the factor could be increased or diminished in succeeding forecasts as the event of precipitation occurrence appears more, or less likely, respectively.

(iii) To provide Probability Factors for decision making.

User Decisions which depend on the occurrence or non-occurrence of precipitation, are usually associated with the possibility of loss if certain measures are not taken. Does the farmer spray or not? Does the caterer plan the function indoors or out? Should they call off the ball game?

In California, at raisin-drying time,the smallest amount of rain is critical, and costly protective measures, such as, rolling up acres of paper trays, will be taken if the probability of rain reaches a certain threshold value, (Kolb and Rapp, 1962).

How is that value determined? After Thompson and Brier (1955), let

C = cost of protection

L = loss suffered if protective measures are not taken and the event occurs

p = probability the event occurs

Then C/L = "cost/loss ratio" and the decision criteria are:

$pL < C$	$\therefore$	$p < C/L$	$\therefore$	do not protect
$pL > C$	$\therefore$	$p > C/L$	$\therefore$	protect
$pL = C$	$\therefore$	$p = C/L$		which is the threshold value.

This illustrates perhaps the most important reason of all for numerical probability factors. For the user, it helps to eliminate the guesswork from the forecast interpretation,and it provides him with a measurement, which, combined with his knowledge of his own operational costs, establishes a decision criterion.

6. PROBABILITY FORECASTS IN THE UNITED STATES

Probability forecasts were introduced to a limited number of U.S. cities in the 1950's. Results at San Francisco, Los Angeles and Hartford, Conn., were favourable, and in 1965 the U.S. Weather Bureau decided to go ahead on a national scale. There was a nine-month trial period, which provided time for offices to acquire familiarity with the probability concept,its verification, and to develop seasonal and synoptic climatologies of precipitation frequency. Limited objective guidance was received from the National Meteorological Center concerning precipitation probability estimates based on the Numerical Weather Prediction prognostics.

In the spring of 1966 the probability forecasts began for real, and our U.S. Weather Bureau colleagues tell us the reaction was anything but passive - some sectors of the public were outspoken in favour of the program, others were almost vitriolic in their opposition. After two years of operation they conducted a sampling survey and found that the greater proportion of public acceptance was among the younger groups,and among those who were better educated.

One difficulty encountered by the U.S.W.B. is due to the fact that a forecast predicts weather starting from time t_0, the time of issue,and that it receives instant and frequent dissemination via Radio for at least the next six hours, i.e., until the next forecast is issued. This creates special problems with regard to probabilities applying to the early part of the valid period. For example, suppose precipitation occurrence has been forecast with a probability of 40% for t_0 to t_{12} and at t_4 it is raining, what then? The forecast, even though correct, will become fair game for those who do not understand the meaning of the probability concept, and we shall discuss a way around this dilemma in the next Section.

On balance the Weather Bureau feels it made the correct decision in going over to probability forecasts, in spite of early problems with public acceptance.

7. PRESENTATION OF THE PROBABILITY FORECAST

It is one matter to establish the case for probability forecasts, but quite another to formulate a proposal for their presentation to the Public. Here we imply presentation in the most general sense of the word. It includes the "package" which we prepare for dissemination by the communications media, as well as what we usually call presentation, i.e., information passed by direct contact of meteorological personnel with the user.

To begin with we shall distinguish between verbal probabilities and numerical probabilities:

(a) Verbal Probabilities. As indicated in the introduction, the Canadian Weather Service prohibits the use of verbal probability modifiers, except for very special circumstances. The case against the use of terms such as, "chance of", "likely", etc., has been (i) lack of definition and (ii) possibility of abuse. If they are defined according to a numerical probability scale, the first objection should disappear.

A suggested verbal guide is as follows:

No qualification	$<$ 10%
Slight chance	10, 20%
Chance	30, 40%
Likely	50, 60, 70%
No qualification	$\geq$ 80%

We recommend that these verbal modifiers be added to the list of precipitation forecast qualifiers now permitted in Canadian forecast terminology. Their use would not, of course, be mandatory, but entirely subject to the forecaster's discretion. This would increase the number of options available to the forecaster to convey the nuances of a precipitation prediction.

(b) Numerical Probabilities. Incorporating numerical probabilities into the body of the forecast can only create confusion. We, therefore,recommend following the U.S.W.B.practice of appending the probability statement to the end of the forecast proper. For example,after the sky condition, precipitation, temperature trend, wind, low and high temperatures, would come a statement such as: "The probability of rain occurrence is 20% today, 70% tonight, and near zero tomorrow". In this way the user, if not interested in the probabilities,can,after getting the forecast, simply "tune-out".

Twelve-hour periods would be used based on:

today	6 A.M. to 6 P.M.
tonight	6 P.M. to 6 A.M.
tomorrow	6 A.M. to 6 P.M.

the number of numerical probabilities in a forecast should be limited to three and, of course, for shorter valid periods, it would be less.

Normally there will be no reason for withholding or modifying the probability statement, but, as suggested by the experience of the U.S.W.B., there will be occasions when the broadcast of a probability applicable to the occurrence of precipitation in the first 12-hour interval may lead to adverse listener reaction. Whenever this can be anticipated, it might be better to withhold release of the probability statement relating to that period.

Therefore, we recommend that the release of the probability statement referring to the first twelve hours,be left entirely to the discretion of the forecaster.

Whether they are released or not,the numerical probabilities should always be evaluated and recorded for each of the twelve-hour periods. This would be for internal use,e.g.,verification, etc. and for distribution on Meteorological Teletype Circuits to Weather Offices. A simple code has been suggested, e.g.,WG 20/70/05. This would correspond to the example of the probability statement quoted earlier in this section.

8. VERIFICATION

General

The present system of verification in the Canadian Weather Service is designed for categorical forecasts, and cannot be applied to Probability Factors. If, for example, the forecast were to indicate a 30% chance of measurable precipitation occurring at a designated site during a specified period of time, one could not really measure the correctness of this particular forecast by the outcome. Rain or no rain, either way the prediction is not invalidated, and to the forecaster it would appear to be the best of all possible worlds! Not really, as the long run will show.

Suppose the forecast probabilities be tabulated over an extended period of time, say one month, during which 120 forecasts will have been issued. Then let them be classified according to the probability value, e.g., 0%, 10% ...100%, and let us note the number N of forecasts in the 30% category. If the number of actual occurrences of measurable rain was, n, the frequency verification will be perfect if

$$\frac{n}{N} \times 100 = 30\% \quad \text{or} \quad \frac{n}{N} = 0.3$$

If $\frac{n}{N} > 0.3$ the forecasts on the average were too optimistic (occurrences n exceeded the expectation .3N). If $\frac{n}{N} < 0.3$ the forecasts on the average were too pessimistic (occurrences n were less than expectation .3N). In this way, by examining $\frac{n}{N}$ for each % category, it will be possible to measure the accuracy and also the bias.

The Brier Score

Verification on the basis of frequency of occurrence is not sufficient. Credit should be given for calling the shot in individual situations. There is a score, due to Brier, which achieves both of these objectives (Brier and Allen, 1951).

The Brier Score, expressed as an average over N forecasts is

$$S = \frac{1}{N} \sum_{i=1}^{N} (f_i - e_i)^2$$

where f_i = forecast probability of occurrence of the event in the i^{th} forecast.

e_i = 1 if the event occurs.

= 0 if the event does not occur.

The object is to minimize $|f_i - e_i|$, which will thereby minimize S; e.g., for the rain or no-rain situation:

if f_i = 1 (i.e., forecast probability of rain occurrence = 100%),

and e_i = 1 (rain occurs), then $|f_i - e_i| = 0.0$.

if f_i = 0.3 (forecast probability rain = 30%),

and e_i = 1, then $|f_i - e_i| = 0.7$.

if f_i = 0 (no rain forecast),

and e_i = 1, then $|f_i - e_i| = 1.0$.

To analyze how this Score measures both the forecaster's ability to sort situations into frequency categories, and his ability to predict individual situations, it should be recast in its Spectrum Form:

$$S = (F-E)^2 + E(1-E)$$

where F is a selected probability f_k defining a subset M of the total N forecasts and $E = e_k = \frac{1}{M} \sum_{i=1}^{M} e_i$ is the posterior or frequency probability computed from what actually did happen during the M events, (Knox, 1969).

The quantity $(F-E)^2$ has been called the "reliability" term,(Hughes 1965). To minimize this term the forecast probability F should equal the relative frequency E. The "reliability" can also be thought of as a measure of the "climat error" of the forecasts,where error is understood to mean the amount of over-forecasting and under-forecasting the frequency of occurrence of precipitation. Usually, in the case of experienced forecasters, this term makes a rather small contribution to the Brier Score (between .03 and .05).

The quantity E (1 - E) is a measure of the "sharpness" of the forecasts (Sanders, 1967). It is minimized, when E = 1, or E = 0, i.e., by recognizing nearly certain instances as often as possible. Put another way, this means combining high confidence (using values of F near extremes of the range) with correctness of result. The "sharpness" term reaches its maximum value (0.25) when E = 0.5.

In summary, the object is to minimize the Brier Score and this will be achieved:

(a) by having the subset forecast probability F correspond as closely as possible to the relative frequency of the event;

(b) by having the forecast probability as close as possible to the extreme ends of the probability scale.

Murphy and Epstein (1967) demonstrate that the Brier Score does not encourage "hedging", because the small gain thus achieved in the "reliability" term is more than offset by the loss in "sharpness".

9. SUMMARY

1. We believe the time has come for the Canadian Weather Service to develop a procedure for conveying to the user some idea of the probability associated with a prediction of precipitation occurrence.

2. The event to which the probability refers should be the occurrence of at least 0.01 inches of precipitation at a specified point during a specified interval of time. These points should be so selected as to be representative (as far as possible) of a city-size local area.

3. The method recommended does not in any fundamental way change the system in use at the present time. The forecasts for Regions and City Reference Points will look exactly the same, except for the occasional inclusion in the text of a few

verbal probability modifiers to be used on an optional basis. At the end of the entire forecast for a given location would be appended the Probability Statement over three, two, or one of the 12-hour periods, and the forecaster would be allowed substantial discretion in regard to whether he wishes to include the first 12-hour probability in the forecast "package" to be released to the public.

4. Total implementation of such a probability forecast program would likely take about twelve months preparation. There would be the need to assemble seasonal climatologies of precipitation occurrence frequencies for the selected Reference Points, and procedures would have to be worked out for the provision of objective guidance material from the C.A.O. and the Weather Central. A substantial proportion of the twelve months would be used by the Weather Offices concerned to produce "dry run" probability forecasts. This would provide the opportunity to acquire experience in this type of forecasting.

5. During this period educational material for the public could be prepared, assembled, and printed. A well-timed properly co-ordinated period of educational publicity via TV, Radio and Press prior to introduction of probability forecasts would be essential.

6. Some in-house training should also be provided to our Presentation Technicians at Weather Offices, and to all Meteorological staff who have direct contact with the public.

7. The program should be systematically evaluated by use of some form of the Brier Score. The calculations required could easily be carried out by computer. This does not in any way imply that the present verification of our categorical forecasts should necessarily be terminated. The two verification programs would be entirely separate.

10. CONCLUSION

It is the conclusion of this paper that the introduction of verbal and numerical probability modifiers would enable the Canadian Public to use Weather Forecasts to better economic advantage.

11. ACKNOWLEDGEMENTS

I wish to acknowledge the kind assistance of my colleagues in the Pacific Region, and in the Meteorological Branch, Toronto.

I would also like to thank Mr. Hazen Bedke, and Mr. L.H. Magar of the Western Region, Mr. L.A. Hughes of the Central Region, as well as E.S.S.A., U.S.W.B., for their splendid responses to my requests for information.

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POLLUTION WIND-ROSE ANALYSIS

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1. INTRODUCTION

This paper describes a method of drawing pollution wind-roses: data from Ottawa, Canada, are used for purposes of illustration. Air quality depends *inter alia* on wind direction, and many types of pollution wind-roses are to be found in the literature (Emslie, 1964), (Marsh and Foster, 1967), (Buchan and Charlson, 1968).

There are two reasons for constructing these diagrams:

(a) for each wind direction, to depict the associated air quality, either as a mean concentration or as a frequency of the time that pollution levels exceed some designated threshold value of interest;

(b) to infer the distribution and strength of emission sources around the sampling station.

These objectives cannot be achieved readily with a single diagram, which is often misinterpreted by the non-specialist, particularly when wind-speed classes are also included. For example, in a standard vector diagram showing the frequency of pollution concentrations exceeding some threshold, a line may be relatively short simply because the wind rarely blows from that direction;using relative frequencies, on the other hand, the line may be much longer (in relation to the other lines) because the airflow from that sector is more stable on the average than from other sectors.

2. SOURCES OF DATA AND LOCAL GEOGRAPHY

A 200-ft. meteorological tower is located at the Central Experimental Farm within the Ottawa city limits (Munn and Stewart, 1967). The Farm is on flat open land, dimensions of about 1-1/3 by 1-1/4 miles, and is surrounded by residential areas (Fig. 1).

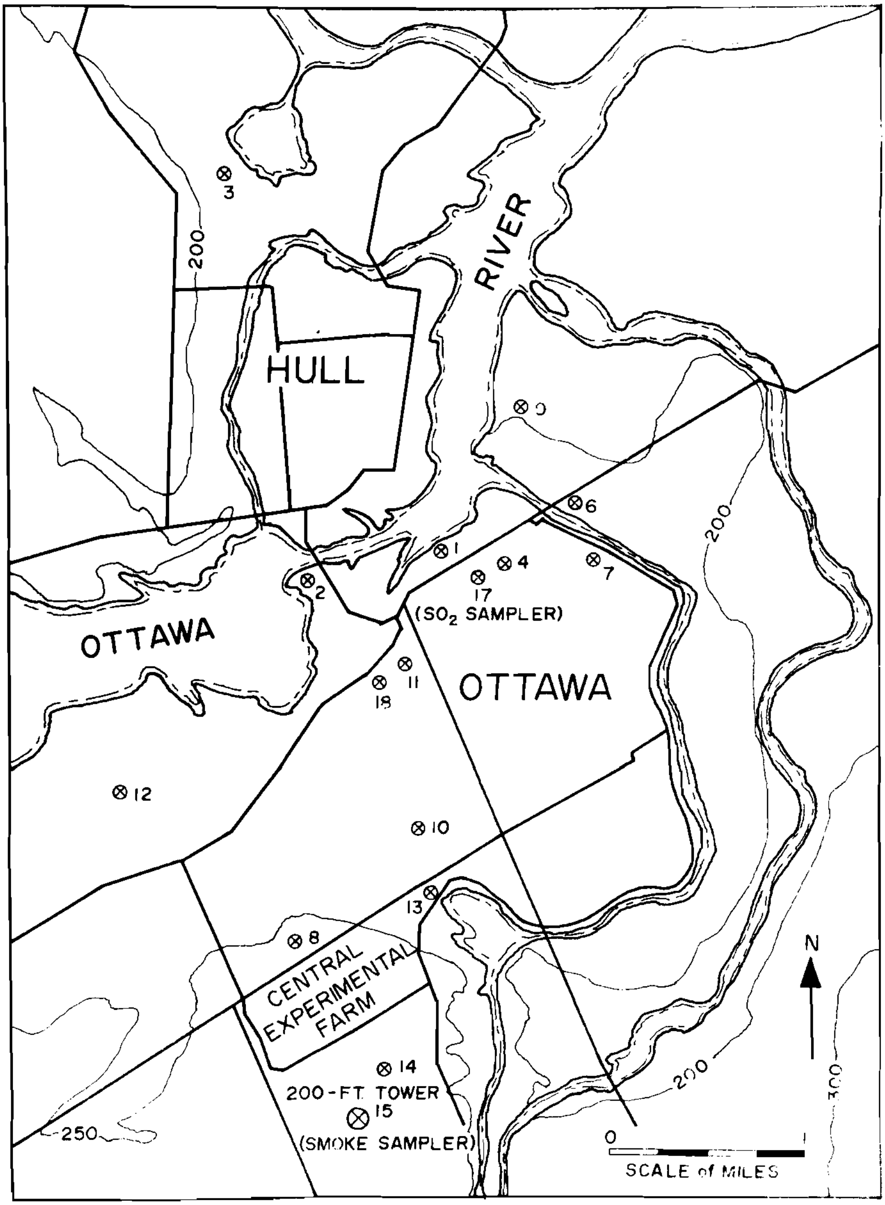

Figure 1. Map of Ottawa, Canada showing locations of sampling stations and principal point-sources of pollution, indicated by numbers 1-18, which represent: 1. Main government power plant, 2. Power plants - paper mills, 3. Canada Cement Plant, 4. Jackson Building, 5. Paper mill (plywood manufacturing), 6,7. Miscellaneous power plants, 8. Civic Hospital, 9. General Hospital, 10. Power plant - Energy, Mines & Resources, 11. St. Vincent's Hospital, 12. Tunney's Pasture power plant, 13, 14. Experimental Farm power plants, 15. Meteorological tower and smoke sampling, 16. Uplands power plant, 17. War Records Building, SO_2 sampling, 18. Brewery.

The 200-ft. wind is used in this investigation because it is the most representative available indicator of Ottawa urban wind flow. Because spatial inhomogenieties undoubtedly exist, only eight points of the compass have been considered. The 20- to 200-ft. vertical temperature difference is also used.

An AISI Smoke Sampler is located at a height of 10 feet near the tower;the observations are in units of COH/1000 linear feet of air, over consecutive 2-hourly sampling periods from May, 1961 to October, 1967.

Between May, 1961 and January, 1965, an SO_2 Thomas Autometer was positioned at a height of 60 ft. on the roof of the War Records Building (Fig. 1). The data are in units of parts per hundred million (pphm).

The major point sources of smoke and SO_2 are also indicated in Fig. 1.

3. PREPARATION OF THE POLLUTION WIND-ROSES

Winds are generally lighter at night than in the daytime, and in summer than in winter. Pollution data must therefore be prestratified by time of day and season if meaningful relations are to be shown. Furthermore, the night-time observations must be separated into inversion and lapse cases; for example, moderately strong 200-ft. winds occur not only with an intense inversion (the low-level jet) but also with a fresh outbreak of unstable arctic air; diffusion patterns are quite different in the two cases. This latter separation is not necessary in the daytime because there is almost always a lapse condition near the ground; the mixing depth undoubtedly changes from day to day but its thickness cannot be monitored from tower observations.

As a further condition, observations for the hours 0700, 0800, 1800 and 1900 EST have been deleted because these are times of transition between day and night conditions. The detailed prestratification criteria are therefore as follows:

(a) Heating season (Nov. to April) and non-heating season (May to Oct.);

(b) Day (0900-1700 EST) and night (2000-0600 EST);

(c) Night inversion and night lapse (isothermals included with inversions).

For each subset, mean values of SO_2 concentration and of smoke density were calculated for calm winds and for five classes of wind speed (1-5,

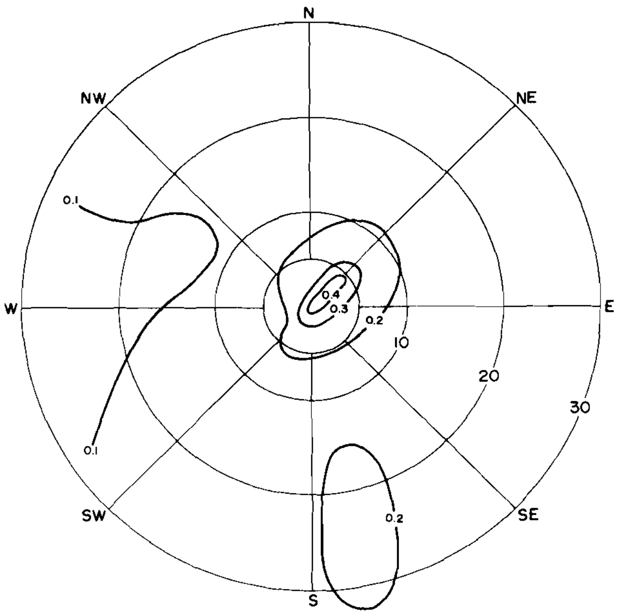

Fig. 2. COH wind rose, daytime summer (4384 cases)

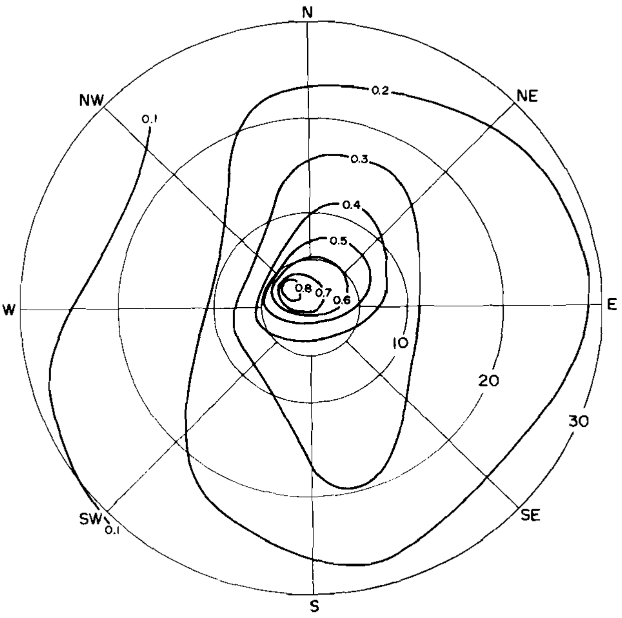

Fig. 3. COH wind rose, daytime winter (4015 cases)

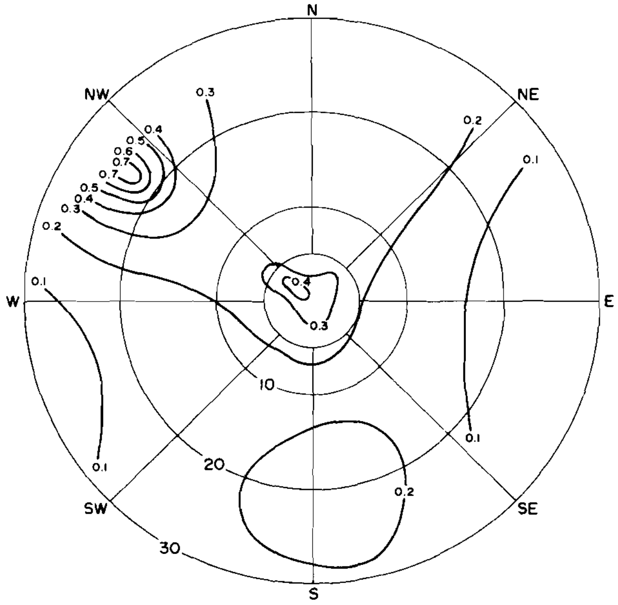

Fig. 4. SO_2 wind rose, daytime summer (4478 cases) (in units of pphm)

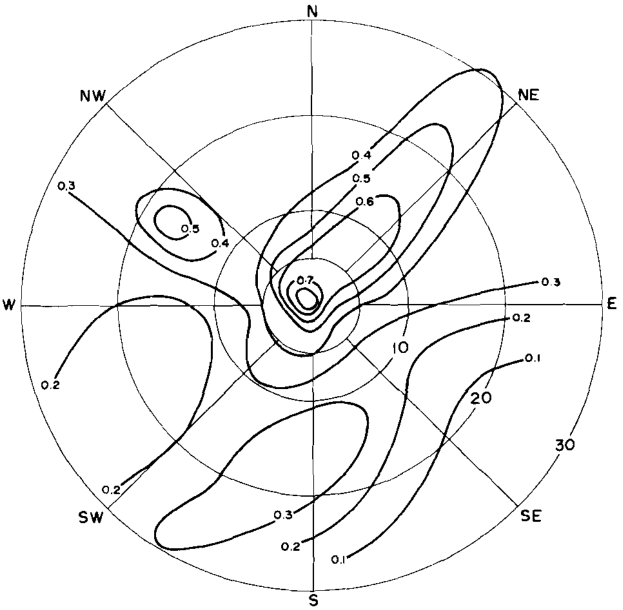

Fig. 5. SO_2 wind rose, daytime winter (4530 cases) (in units of pphm)

6-10, 11-15, 16-20, 21-25 and 26-30 mph). These means were plotted on vector diagrams (Figs. 2-13), and isopleths drawn. The number of cases in Figs. 2-13 are, respectively, 4384, 4015, 4478, 4530, 1190, 2345, 2175, 3991, 3014, 1748, 3308 and 1934.

Because the cumulative frequencies of pollution concentrations at a single station are usually distributed lognormally, Zimmer and Larsen (1965) have argued that a geometric mean is more meaningful than an arithmetic mean. However, the latter statistic is satisfactory for a qualitative interpretation of the relative influences of point sources on air quality.

4. DAYTIME OBSERVATIONS

Figs. 2-5 display the daytime summer and winter pollution wind-roses for smoke and SO_2. Because there is no separation into inversion and lapse subsets, the data samples are about twice as large as those in Figs. 6-13 (Sections 5 and 6). In these and subsequent diagrams, winter values are higher than summer ones because of the increased emissions.

The isopleths of COH values (Figs. 2-3) are slightly elliptical. Air quality is poorest when the wind is north-easterly, i.e., from the urban centre of Ottawa. There is also a strong dependence on wind speed; COH values increase as the wind speed decreases.

The SO_2 concentrations in summer (Fig. 4) are generally low, with the exception of the peak with north-westerly winds in the speed class 21-25 mph. Because this peak is based on 22 cases and similar peaks occur in other diagrams, there is no reason not to accept it. Examination of Fig. 1 suggests that the likely cause is downwash from source 1, the main government power plant, which operates in summer as well as winter.

The SO_2 concentrations in winter (Fig. 5) again show a peak with north-westerly winds, this time in the class 16-20 mph and based on 150 cases (the next higher wind speed class, 21-25 mph, has 40 cases). Pollution values are also high with north-easterly winds, associated with the multiple sources in that direction; most of these point sources are absent in summer.

5. NIGHT-TIME LAPSE OBSERVATIONS

The isopleths of COH values in both summer and winter (Figs. 6-7) reveal that air quality is poorest with north winds, particularly with the lighter speeds.

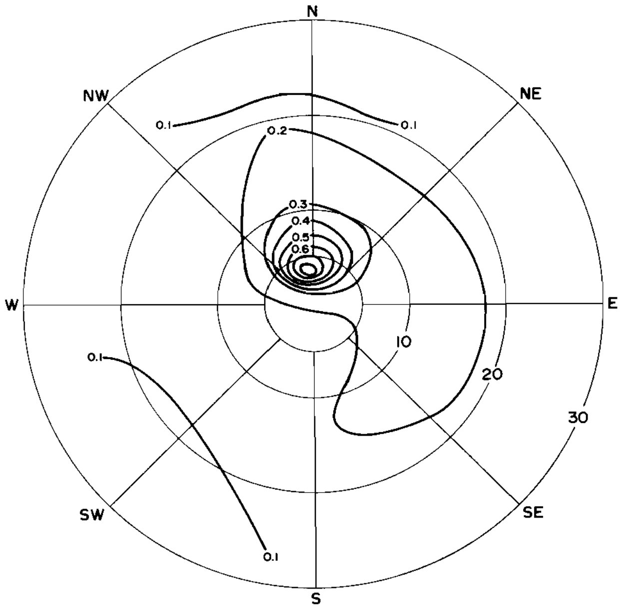

Fig. 6. COH wind rose, night summer lapse (1190 cases)

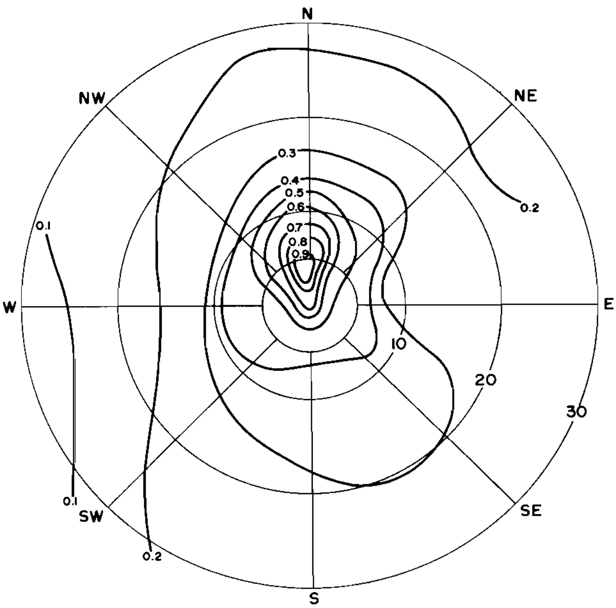

Fig. 7. COH wind rose, night winter lapse (2345 cases)

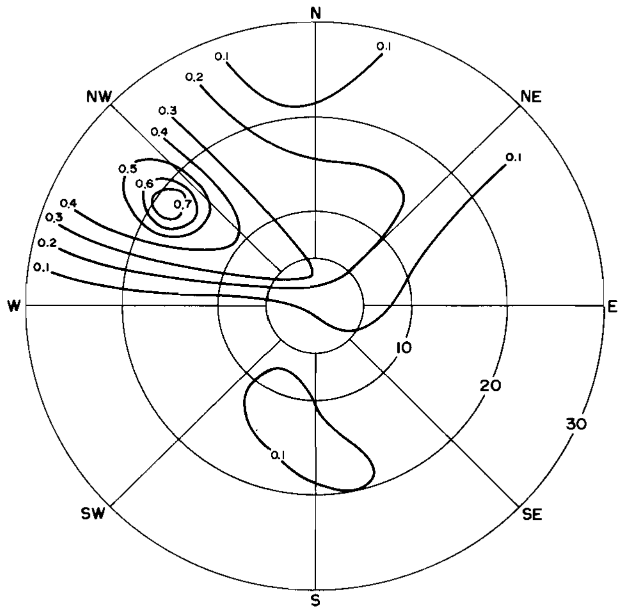

Fig. 8. SO_2 wind rose, night summer lapse (2175 cases)
(in units of pphm)

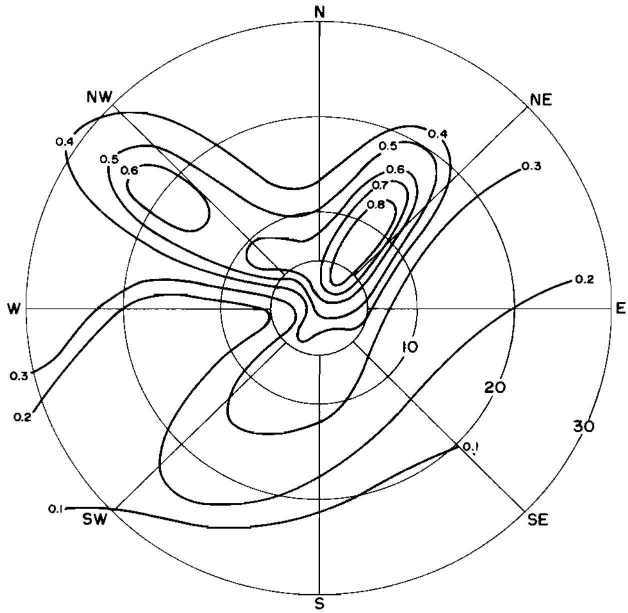

Fig. 9. SO_2 wind rose, night winter lapse (3991 cases)
(in units of pphm)

The SO_2 concentrations in summer (Fig. 8) again show a peak with north-westerly winds, 16-20 mph (62 cases). The SO_2 wind-rose in winter (Fig. 9) is similar to that for daytime observations (Fig. 5) at that time of year, and no further comment is needed.

6. NIGHT-TIME INVERSION OBSERVATIONS

The isopleths of COH values (Figs. 10-11) show a similar pattern during inversion conditions as in night-time lapse cases (Figs. 6-7), but the absolute values are seasonally higher. This is to be expected; an inversion inhibits the upward diffusion of pollution.

When examining Figs. 12-13 (SO_2 isopleths in summer and winter, during inversions), an important consideration is that the SO_2 sampler was on the roof of the War Records Building whereas the vertical temperature difference was measured at the Central Experimental Farm, 2-3/4 miles distant in a suburban location. For night-time lapse and for daytime observations (Figs.4, 5, 8, 9),the spatial separation is not significant because when there is no inversion at the tower, there is not likely to be one at the War Records Building. The converse is not true, however. In many cases of an inversion at the Experimental Farm, the War Records Building was undoubtedly within an urban mixing layer, with an upper inversion that might result in a continuous fumigation from elevated sources.

Comparison of Fig. 12 (summer inversion SO_2) with Fig. 8 (summer night-time lapse SO_2) reveals similar patterns but higher general levels of pollution. It seems that the downwash with north-westerly winds occurs in summer even when there is an inversion at the Central Experimental Farm.

Fig. 13 (winter inversion SO_2) is the most interesting of all the diagrams. The north-westerly peak with 15-20 mph speeds is not present, indicating that the urban mixing layer is relatively shallow in winter on the upwind side of the built-up area; presumably the plume from the main government power plant (Source 1) must pass overhead at the sampler location without fumigation. The peaks that do occur (with north-north-west, north-north-east and south-south-west winds) are probably due to low-level wintertime sources. There are hints of similar peaks in Fig. 9 (night winter lapse) and Fig. 5 (daytime winter) but only in Fig. 13 are they pronounced.

7. CONCLUSION

When a pollution wind-rose is to be interpreted in terms of the distribution of sources in the surrounding area, the data must be pre-stratified. As a very minimum, separate wind-roses should be drawn for

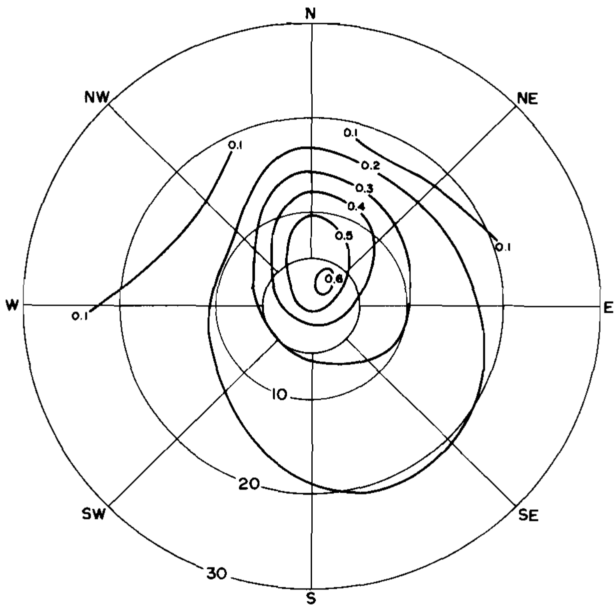

Fig. 10. COH wind rose, night summer inversion (3014 cases)

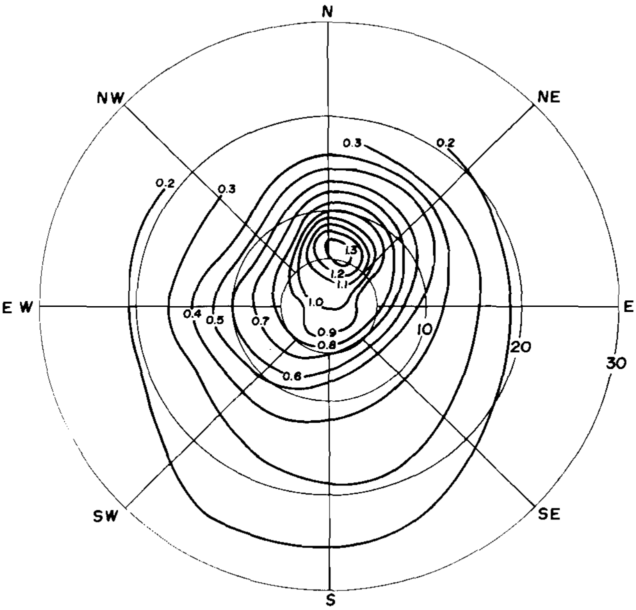

Fig. 11. COH wind rose, night winter inversion (1748 cases)

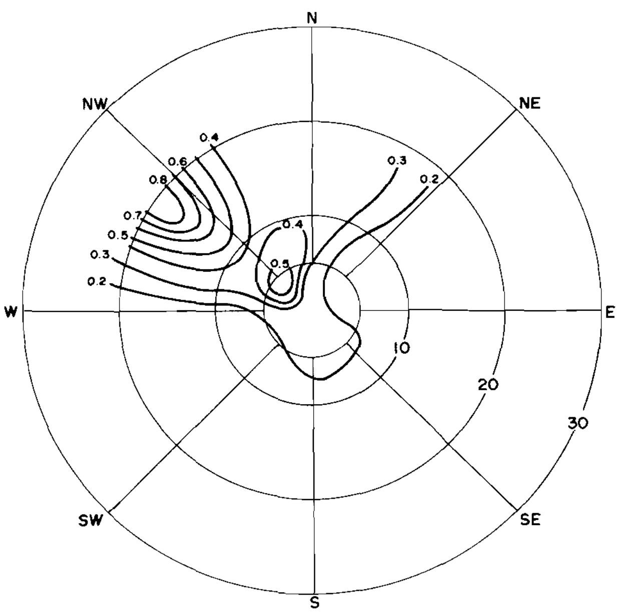

Fig. 12. SO_2 wind rose, night summer inversion (3308 cases) (in units of pphm)

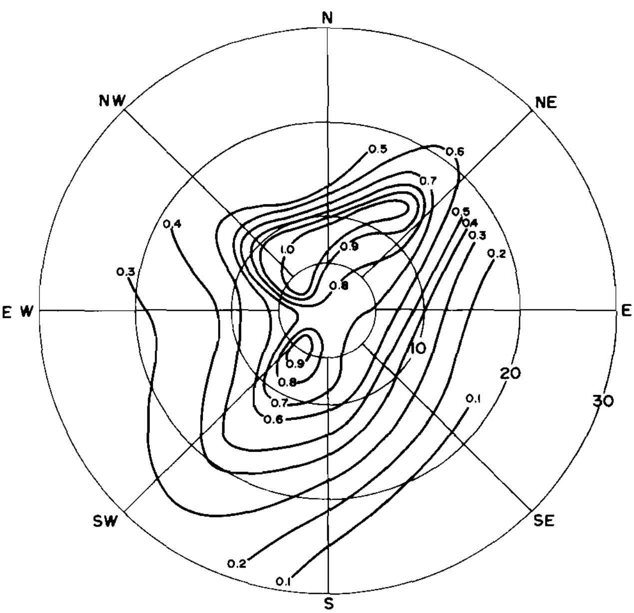

Fig. 13. SO_2 wind rose, night winter inversion (1934 cases) (in units of pphm)

the heating and non-heating seasons, for daylight hours, and for night-time lapse and night-time inversion conditions. This is particularly important at locations subject to night-day reversals of land and sea-breezes or downslope/upslope flows.

There are no measurements of vertical temperature difference in many cities. The pollution wind-roses should then be constructed for daylight hours only, with a separation into winter and summer cases.

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Munn, R.E.,and I.M. Stewart, 1967: The Use Of Meteorological Towers In Urban Air Pollution Programs. J. Air Poll. Cont. Assoc. 17, 98-101.

Zimmer, C.E.,and R.I. Larsen, 1965: Calculating air quality and its Control. J. Air Poll. Cont. Assoc. 15, 565-572.

A VOICE FOR CANADIAN SCIENCE?

A meeting of representatives of 60 national scientific societies was held at Carleton University, Ottawa, on July 31 and August 1, 1969, to discuss "How can the scientific community make its maximum contribution to national decisions?" The conference was organized by a steering committee consisting of representatives of the Canadian Association of Physicists, the Chemical Institute of Canada, the Engineering Institute of Canada, and the Canadian Medical Association. Invitations to attend were sent to all national scientific and technical societies, and the conference was attended by more than a hundred people representing 60 national societies with more than 100,000 individual members. Our Society was represented by the writer of this report.

Senators Lamontagne,Cameron and Grosart spoke at the first session, as did representatives of the government's science organizations - Uffen (Science Secretariat); Gaudry (Science Council); Schneider (National Research Council); Brown (Medical Research Council); and L'Heureux (Defence Research Board). The remarks of the Senate and government representatives may be summarized as follows:

1. The scientific community, outside of government agencies, has a role to play in assisting in the formulation of Canada's science policy.

2. Responsibility for the provision of synthesized opinions and advice lies with the scientific community.

3. The Science Secretariat and Science Council are most eager to have the scientific societies establish some sort of congress, conference or forum to discuss national policies involving science and to express the views of the scientific societies to government.

4. The social sciences must be included with the physical, biological and medical sciences.

5. Unless the non-governmental scientific organizations organize such a forum to speak for science and do so, there will probably be a lack of government support for science in Canada.

Following many hours of discussion, the following motion was passed unanimously:

"This conference expresses:

1. its urgent conviction that an organization representative of Canadian science and technology be established to speak for the scientific community of Canada in questions of national interest;

2. its desire that the present steering committee be charged with the responsibility for creating a founding committee for the new organization, this founding committee to be broadly representative of Canadian science; and

3. its desire that the founding committee prepare proposals with respect to goals and appropriate structures for this organization for submission to a reconvened assembly of representatives and to the societies which they represent".

IMPLICATIONS FOR OUR SOCIETY

While our Society was by no means the smallest one represented at the conference,the leading roles in this movement will have to be played by those societies with thousands of members and permanent secretariats. However, there are a few facts about meteorology which will give us an opportunity, I believe, to contribute and participate to a far greater extent than our numbers might indicate. First, an increasing number of our national problems concern the environment - pollution, water, renewable resources, etc. To properly tackle any one of these problems, considerable attention must be given to atmospheric science. Secondly, a majority of our members are employed in applied meteorology - weather forecasting, meteorological and climatological consulting, etc., in contrast to the situation in many sciences where most professionals are engaged in research. Because of this emphasis on applied meteorology with concern for the user,meteorologists are in an excellent position to act as intermediaries between the research scientists on one side, and the engineers, economists and planners on the other. Consequently, I believe that meteorology has a large role to play in helping to frame some parts of Canada's science policy and this role is entirely out of proportion to the relative percentage of Canadian scientists who are meteorologists.

To utilize the knowledge which we have acquired in our profession and to ensure that we have opportunities to present our points of view, I believe that the Society should support this movement to establish some sort of overall federation, congress or forum. After the proposed second meeting in December, I hope that we will be able to consider and ratify our membership in the group. It is only in this way that we will be able to voice effectively our opinions on the multi-disciplinary science policy questions which must be brought before the government during the next yew years.

M.K. Thomas,
President.

INTER ALIA

NEWS ABOUT MEMBERS

Several more signs of the increasing worldwide co-operation amongst societies to participate in the advancement of the science of meteorology are indicated by a recent list of members elected to our Society. Two such members are PROFESSOR F. KENNETH HARE of the Department of Geography at the University of Toronto, who is a Vice-President of the Royal Meteorological Society, and KENNETH C. SPENGLER, Executive Director of the American Meteorological Society.

DR. C.L. MATEER rejoined the Atmospheric Research Section at Meteorological Branch Headquarters as Supervisor of Physical Research during summer 1969. During the past three years he had been Program Scientist in the Atmospheric Optics and Radiation Group at the National Center for Atmospheric Research in Boulder, Colorado. At NCAR, Dr. Mateer actively investigated the light scattered by atmospheric molecules and dust. In one study, he attempted to explain the colour bands, observed from the manned satellite Mercury -8, through the use of model atmospheres containing various amounts of ozone, dust or aerosols distributed continuously or in layers throughout the vertical.

Dr. R.E. MUNN, one of ATMOSPHERE's most frequent contributors, has been accorded a distinctive honour in recognition of his prolific and original contributions in the field of micrometeorology. He has been invited by the Institute of Meteorology at the University of Stockholm to deliver lectures in air pollution meteorology, to participate in seminars and to conduct his own research during the academic year 1969 - 1970. As a visiting scientist Dr. Munn will reside at the Wenner-Gren Centre from January 5th until July 1970.

- continued on Page 118

REVIEW

WEATHER AND LIFE

By William P. Lowry
Oregon State University

Academic Press, New York, 1969, 305 pages ($5.95)

T.J. Gillespie
University of Guelph

Professor Lowry indicates in the preface of Weather and Life that the book grew out of notes developed for a single-term course taught at Oregon State University to students from a wide variety of backgrounds. The reader should be alerted that a book written within these constraints must necessarily present a "broad brush" treatment of the subject and will omit a great deal of mathematical detail. In a nutshell, Weather and Life is primarily descriptive, with useful equations stated rather than derived.

Section I, entitled "The Physical Environment", and Section II, "Energy Budgets", lay the meteorological foundation. To the person formally trained in the Atmospheric Sciences these pages constitute a light refresher on radiation, soil and air temperature, moisture, wind and turbulent transfer near the earth's surface. Later in the chapter on radiation the author unfortunately perpetuates the myth that heating observed in a greenhouse is primarily due to differential absorption of long- and short-wave radiation by glass; a point that should have been corrected before the text went to press. Chapters 4 and 5 go on to deal with temperature and moisture. Most meteorologists will be very familiar with the ideas presented on heat and water in the atmosphere but will find here some interesting, less familiar material concerning energy and water fluxes in the soil. A standard treatment of elementary turbulent transfer theory follows. Then the next two chapters cover applications of the energy budget concept which Lowry rightfully emphasizes as a very important tool in biometeorology. Section II ends with "Instrumentation and Data Collection", a chapter containing far less than the title promises. Some good basic requirements for proper data collection are set down but the ensuing pages belabour these points excessively, in my opinion. The reader will find no information on the special instruments of biometeorology in this book.

Sections III and IV, "The Biological Environment" and "The Urban Environment", truly deal with weather and life. I believe the kind of information contained in these pages will soon be vital to many practicing meteorologists. Lowry says, "describing the environment is not the objective. Describing the environment is only a means to reaching the objective. Explaining things about organisms is the objective." Indeed, demands are increasing daily that meteorologists say not simply what the weather will *be*, but what it will *mean* in terms of human health, food production or other biological processes.

A whirlwind tour of Sections III and IV is made below with a few pauses at points of interest. Lowry opens with a generally good introduction to photosynthesis and transpiration although he implies in error that only 30% of full sunlight is sufficient to saturate the photosynthetic capacity of even "sun plants". In fact, according to Hesketh, some leaves (corn leaves for example) continue to increase their consumption of CO_2 beyond the light levels of even the brightest summer day. He introduces the useful electrical analogue model of water flow in plants and shows that wind affects transpiration significantly only at low speeds. In Chapter 11 the difference between growth and development is emphasized and the "heat units" concept is outlined. The author says he is not aware of any application of this concept in predicting the likelihood of successful crop growth from weather data alone; but this system is widely used today in rating and recommending corn varieties in Ontario. Some biometeorological information about fish and insects is followed by a chapter on higher animal and human biometeorology containing an anomalously large number of equations. To appreciate these fully the reader must fill in the algebra between steps but he will be rewarded by the interesting story these equations have to tell. For example, the many subtle ways in which the Eskimo igloo is amazingly suited to its environment are revealed. The book deals next with the urban climate, then briefly considers air pollution, and finally closes with the sensible warning that either the rate of man's modification of the bioenvironment must decrease or his knowledge of the bioenvironment must quickly increase if things are to be kept within bounds.

In summary, *Weather and Life* is not a source of detail on any aspect of biometeorology and is thus not recommended as an essential reference book for the interested scientist's bookshelf. It could, however, very profitably be included in the library of any forecast office or atmospheric research establishment. At the end of each chapter a short bibliography is given for those requiring more detail in a particular area. Reading this book is a good way to begin learning how the physical and biological environments fit together.

MEETINGS

The first meeting of the Toronto Centre for the 1969-70 season was held on Tuesday, October 7, 1969. The members were very fortunate to hear Dr. D.V. Anderson of the Department of Mathematics, University of Toronto, speak on "Why Bother with Research".

Dr. Anderson called on scientists to re-assess the objectives and priorities of their research efforts in light of the requirements of today's society and to undertake a more relevant and systematic approach. In particular, he deplored the lack of communication between the public and the scientist. In the field of Great Lakes Research, he hoped that the Users Conference* would help meet this requirement.

While acknowledging that considerable good work had already been done, Dr. Anderson could not help but wonder why it is so often ignored. Why, he asked, was the St. Lawrence Seaway built to specifications laid down 50 years ago, almost completely ignoring recent advances in technology and present-day requirements. Dr. Anderson termed it a "major engineering blunder". The public, he felt, was well justified in questioning the value of research.

The lively discussion which followed was clear evidence that Dr. Anderson's remarks had struck home.

Scheduled meetings of the Toronto Centre include tours of both the Nuclear Power Generating Station at Pickering and the Centennial Centre for Science and Technology and an address by Dr. F.K. Hare on "Carbon Dioxide & All That".

The 1969-70 executive comprise: Mr. T.L. Wiacek - Chairman; Mr. T. Galler - Treasurer; Mr. D.K.A. Gillies - Program Chairman; and Mr. M.S. Webb - Secretary.

*"A Conference for the Users of the Great Lakes", Toronto, November 3-4, 1969.

CONFERENCE ON

THE GLOBAL CIRCULATION OF THE ATMOSPHERE

The Canadian Meteorological Society participated in the Conference on the Global Circulation of the Atmosphere held by the Royal Meteorological Society and the American Meteorological Society in collaboration with the Royal Society of London during 25-29th August, 1969, in London. A report on this Conference is given below in the article reprinted from NATURE, London, Vol. 223, September 6, 1969.

METEOROLOGY

WORLD WEATHER SYSTEMS

from a Correspondent

METEOROLOGY has often been referred to as an "inexact science",both by meteorologists themselves and, in sometimes rather coarser terms, by the general public. The question of how and why atmospheric motions on various scales behave as they do, and of how they interact with each other, is indeed complex and by no means perfectly understood. It is thus heartening to record the progress being made towards a fuller understanding of the problem , as reported by the speakers at the conference on the global circulation of the atmosphere, held at the Royal Society from August 25 to 29, under the joint auspices of the Royal Meteorological Society and the American Meteorological Society.

Two principal factors have contributed to this progress: new techniques of data acquisition and the advent of computers of sufficient capacity to carry out numerical simulation of atmospheric processes on a global scale. In the first category, the most exciting developments are in satellite meteorology, which was reviewed by Professor V.E. Suomi (University of Wisconsin). The daily use of nephanalyses obtained from satellite photographs is already taken for granted, and the shape of things to come was presented in the form of hemispheric pressure-level contour charts derived entirely from satellite data.

E.R. Reiter (Colorado State University) presented some new results obtained from the GHOST project, in which balloons floating at approximately constant heights are tracked for periods of the order of months, providing information about the wind fields at various heights. These have already revealed some interesting differences between the northern and the southern hemispheres in the relationship between the Eulerian and Lagrangian spectra of atmospheric motions.

Considering smaller-scale motions, K.A. Browning (Meteorological Office) described the use of Doppler radar to determine the mesoscale structure of frontal systems. He described a particular example of a cold front in which the vertical motions were concentrated within a belt only 2 km wide, with a maximum updraught exceeding 8 m per second.

Meanwhile, considerable progress is being made in the development of numerical models of the atmosphere. Professor J. Smagorinsky (ESSA and Princeton University) reviewed their contribution towards understanding the global circulation, while J.D. Stackpole (US Weather Bureau)described the use of numerical models in operational medium-range forecasting. These two papers illustrated the difference in emphasis between the two aspects of numerical simulation.

In the closing session of the conference, Professor B. Bolin (University of Stockholm)set out the current position with regard to the planning and implementation of GARP (Global Atmospheric Research Programme). The enthusiasm expressed from the floor during the ensuing discussion left no doubt about the optimism that a fuller understanding of the Earth's atmosphere will come from this massive programme of data acquisition and research.

Regarding the conference as a medium of education, it is a pity that more speakers are not aware that progress has been made in this field as well as their own. In particular, the potential of visual aids was not always realized: the film illustrating laboratory models of the atmosphere given by R. Hide (Meteorological Office), the animated pressure charts presented by W.M. Washington (NCAR), and the use of slides to demonstrate the role of the tropics in the general circulation by D.H. Johnson (Meteorological Office) all pointed the way to what can be done.

GREAT LAKES RESEARCH CONFERENCE

The 13th Conference on Great Lakes Research will be held in Buffalo, New York, on 31 March through 3 April, 1970.

Sponsored by the International Association for Great Lakes Research, the Conference is being co-hosted by Cornell Aeronautical Laboratory and the Great Lakes Laboratory of the State University College at Buffalo.

Further information may be obtained by contacting either Dr. Gerhard Neumaier, P.O. Box 235, Buffalo, New York 14221 (Telephone - 716 - 632-7500 Ext. 676) or Dr. Robert A. Sweeney, 5 Porter Avenue, Buffalo, New York 14201 (Telephone - 716 - 862-5422).

FOURTH ANNUAL CONGRESS

The Fourth Annual Congress and Annual General Meeting of the Canadian Meteorological Society will be held at the University of Manitoba June 17-19, 1970, in conjunction with the Conference of Learned Societies. The theme of the Congress is "Education in Meteorology", but sessions for the presentation of technical papers in various areas of Meteorological research will also be held. A call for papers will be issued in due course by Program Chairman Dr.John Maybank and information on registration, accommodation, etc., will also be provided through the courtesy of the Winnipeg Centre, which is looking after local arrangements. In the meantime, it is hoped that interested members will make plans to keep these dates open for attendance at the meetings and incidentally, to take part in the celebrations of Manitoba's Centennial as a province, which is the occasion leading to the invitation from the University of Manitoba to hold our Congress there.

INTERNATIONAL MEETING OF SOLAR ENERGY SOCIETY

The 1970 meeting of the Solar Energy Society will be held at the National Science Center, Clunies Ross House, Melbourne, Victoria, Australia, from Monday, March 2, to Friday, March 6, 1970. This gathering will be the most comprehensive conference on the subject of solar energy and its utilization since the 1961 UNESCO meeting in Rome. Some ninety papers will be presented, covering every aspect of the work now being undertaken throughout the world to apply solar radiation to the beneficial use of mankind.

THE SOLAR ENERGY SOCIETY was founded in Phoenix, Arizona, following the 1954 International Conference on Applied Solar Energy. The Society's headquarters are situated on the campus of Arizona State University at Tempe, and members are now located in fifty nations. Most of these countries are expected to be represented at the Melbourne meeting in March.

For further information, inquiries may be addressed to:

Mr. F.G. Hogg, Conference Organizer,
International Solar Energy Conference,
C.S.I.R.O., Post Office Box 26,
Highett, Victoria 3190,
Australia.

or to: Mr. John I. Yellott,
Solar Energy Society,
Arizona State University,
Tempe, Arizona 85281,
U.S.A.

SYMPOSIUM ON MAN-MADE LAKES
Their Problems and Environmental Effects

An International Symposium on Man-Made Lakes, Their Problems and Environmental Effects will be held at Knoxville, Tennessee, U.S.A., on May 3-7, 1971. The conference should be of interest to a broad range of scientists, engineers, and project managers.

The conference is being organized by the Scientific Committee on Water Research (COWAR) on behalf of the International Council of Scientific Unions (ICSU). Numerous Unions and Committees of ICSU are co-operating, and agencies of the United Nations are providing support. Arrangements in the United States are by the National Academy of Sciences and the Tennessee Valley Authority (TVA).

The Symposium will assess recent findings, summarize knowledge, and point to needed research on man-made lakes. Principal topics will be water temperature and chemical quality; aquatic ecosystems including eutrophication, aquatic weeds, and fishery biology; siltation including amounts, control, and removal;effects upon adjoining terrestrial ecosystems; seepage; microclimate and evaporation; fishery development; resettlement and marginal agriculture; public health effects including water vectors, insects, and water quality; seismic problems;and recreation and transportation effects.

The Symposium will be organized around (1) broad,inter-disciplinary case studies of the world's great man-made lakes and collections of lakes, (2) regional summaries and discussion of the several conference topics, and (3) visits to TVA projects and other facilities of interest. All sessions will be plenary. Individual papers are invited, and those which are accepted will be summarized and discussed at the Symposium and reproduced in full in the Proceedings. Abstracts are solicited before May 1, 1970.

Address all inquiries regarding attendance and participation to:

Prof. William C. Ackermann, President
Scientific Committee on Water Research
Illinois State Water Survey
Box 232, Urbana, Illinois, 61801, USA

NOTES FROM COUNCIL

The following was elected to membership at the September 23, 1969, meeting of Council:

Member

Albert Edward Boyer

The following were elected to membership at the October 29, 1969, meeting of Council:

Member

E. Brewster Buxton
John Edward Hay
Morris Katz

Student

Hubert Allard
Vincent Capogreco
Michael David Hewson
John Patrick Kelly
Robert William Kelly
Roger Leonard
Edgar Melvin Loder
Eldon John Oja
Joseph Edward Shaykewich
Stanley John Siok
Gary Gerald Thielmann
Jack Man Woo*

*1970 membership

CALL FOR NOMINATIONS

Nominations are requested from members and Centres for the 1969 Society Awards to be presented at the 1970 Annual Meeting. Four awards are open for competition: 1) the President's Prize for an outstanding contribution in the field of meteorology by a member of the Society; 2) the Prize in Applied Meteorology for an outstanding contribution in the field of applied meteorology by a member; 3) the Graduate Student Prize for a contribution of special merit by a graduate student; and 4) the Dr. Andrew Thomson Undergraduate Student Prize for a contribution of special merit by an undergraduate student. The awards will be made on the basis of contributions during the 1969 calendar year. Nominations should reach the Corresponding Secretary not later than March 1, 1970.

APPOINTMENT OF COMMITTEES

Council appointed Committees for the ensuing year at the October 29, 1969 meeting, as given below. The President is an ex officio member of all Committees.

Nominating Committee	:	Prof. A.W. Brewer, Chairman H.C. Belhouse G.H. Legg
Membership Committee	:	C.B. Adamson, Chairman J.D. Holland (ex officio) A representative from each Centre
Awards Committee	:	G.A. McKay, Chairman Rev. C. East Prof. K.D. Hage
Editorial Committee	:	E.J. Truhlar, Chairman J.A.W. McCulloch H.B. Kruger R.E. Munn
Centres Committee	:	D.N. McMullen, Chairman With power to add
Development Committee*	:	C.M. Penner, Chairman W.S. Appleby (student) Prof. A.W. Brewer A.D. Christie P.J. Denison G.Y. Ishii H.B. Kruger D.N. McMullen R.S. Schemenauer (student) A.W. Smith M.S. Webb

*Approval to form this Committee was granted by the members at the Third Annual General Meeting of the Society, in May, 1969, at Toronto.

MEMBERSHIP DRIVE

The recruiting of new members is a continuous process. Even though efforts in this regard have been excellent to-date, the National Membership Committee considers that it should contribute more to this endeavour than in the past by co-ordinating these activities more closely with the Local Centres.

In October a letter was sent to the various Centres outlining a general plan for increasing membership in the Canadian Meteorological Society. Enclosed with this letter were Membership Application Forms, each of which contained a brief outline of the history, aims and activities of the Society, suitable for posting as a notice.

Lists are being prepared of the names of Meteorological Branch Meteorologists residing in the area of each Centre but who are not members. These lists may be helpful in providing a starting point for local recruiting activities.

The technical staff within the Meteorological Branch may also prove to be a potentially valuable source of new members.

If any member has ideas on how or where new members may be found and recruited, please inform your local or national executive. All thoughts and suggestions on this vital subject will be carefully considered by your National Membership Committee.

C.B. Adamson,
Chairman,
National Membership Committee

INTER ALIA - continued from Page 108

NEW JOURNAL

Reidel Publishing Company in the Netherlands has decided to begin publication of a new journal, Boundary-Layer Meteorology, an interdisciplinary journal on physical and biological processes in the atmospheric boundary layer. Volume 1, Number 1 is planned for February 1970. Editor-in-Chief is Dr. R.E. Munn, and included amongst those on the Editorial Board are the following Canadians (all members of the CMS): Dr. P.J. Barry, Prof. A.G. Davenport, Prof. M. Miyake, and E.J. Truhlar.

CANADIAN THESES

An annual publication which may be of interest to Meteorologists and other scientists alike is Canadian Theses/Thèses Canadiennes, prepared by the Cataloguing Branch of the National Library in Ottawa. Each issue contains the titles and names of authors for all theses completed during an academic year at the Bachelor's, Master's and Doctoral levels at all Canadian Universities.

It can be obtained (if in stock) from local Queen's Printer Bookshops or ordered from the Publications Branch, Queen's Printer, Ottawa (but not from the National Library). Payment is required at the time the order is placed, with remittance payable to the Receiver General of Canada. Inquiries regarding standing orders should be addressed to the Queen's Printer.

The following issues have been published:

Year	Price	Catalogue Number
1952	out of print	
1960-61	out of print	
1961-62	out of print	
1962-63	out of print	
1963-64	\$1.30	SN2-4/1964
1964-65	\$1.50	SN2-4/1965
1965-66	\$1.50	SN2-4/1966
1966-67	\$1.50	SN2-4/1967
1967-68	\$1.50-\$2.00	SN2-4/1968

NOTES TO MEMBERS

It would be appreciated if members would donate to the CMS Archives copies of the following issues of ATMOSPHERE which are either out-of-print or in short supply:

Volume 1, Nos. 1, 2, 3 (1963)

Volume 2, Nos. 1, 2 (1964)

Special "3RD Annual Congress" issue (1969)

ERRATUM

OR
EDITOR AT SEA
OR
SEE NO EVIL
OR
EAST IS EAST, AND WEST IS WEST....,
OR
ETC.,

CUM AMORE AD AEREM*

Instrument Division of the Meteorological Branch in past years has to no avail attempted to interest the Branch in an oceanographic station. What to our surprise in Vol. 7 No. 2, 1969 ATMOSPHERE - a golden opportunity! Will you please enlist Oceanographer Green on the Aldergrove "30 miles west of Vancouver Airport".

S.W. Dewar

*Latin for "atmosphere", not for "error" (Ed.)

INSTRUCTIONS TO AUTHORS

1. Manuscripts shall be submitted in duplicate, typed doubled-spaced on $8\frac{1}{2}$ x 11" bond, with the pages numbered consecutively.

2. Two copies of figures shall be submitted with the manuscript. The originals should be retained by the author until it is established whether or not revisions will be required. A list of the legends for figures shall be typed together on a separate sheet.

3. Authors shall keep in mind when labelling that figures will require reduction to 5" x 8" (full page) or smaller. Photographs shall be glossy prints with good contrast. Other diagrams shall be drawn with pen and ink and be in final form for photographing.

4. Literature citations in the text shall be by author and date. The list of references should be primarily alphabetical by author, and secondly chronological for each author.

5. Units should be abbreviated only if they are accompanied by numerals. For example, 10 km, but several kilometers.

6. Tables shall be prepared on separate pages each with an explanatory title. Only essential vertical and horizontal ruling will be included.

7. Metric Units are preferred.

8. Footnotes to the text should be avoided.

Schedule Of Charges For Reprints

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The next 500 pages	Cost	3 cents per page	-	$15.00
The next 500 pages	Cost	2 cents per page	-	$10.00
All additional pages	Cost	1 cent each		
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	TOTAL:	-	$55.00

THE CANADIAN METEOROLOGICAL SOCIETY
La Société Météorologique du Canada

The Canadian Meteorological Society came into being on January 1, 1967, replacing the Canadian Branch of the Royal Meteorological Society, which had been established in 1940. The Society exists for the advancement of Meteorology and membership is open to persons and organizations having an interest in Meteorology. There are local centres of the Society in several of the larger cities of Canada where papers are read and discussions held on subjects of meteorological interest. Atmosphere is the official publication of the Society. Since its founding, the Society has continued the custom begun by the Canadian Branch of the RMS of holding an annual congress each spring, which serves as a National Meteorological Congress.

For further information regarding membership,please write to the Corresponding Secretary, Canadian Meteorological Society, P. O. Box 851, Adelaide Street Post Office, Toronto 210, Ontario.

There are three types of membership - Member, Corporate Member and Student Member. For 1969, the dues are \$7.50, \$25.00 and \$1.00, respectively. Atmosphere is distributed free to all types of member. Applications for membership should be accompanied by a cheque made payable to The Canadian Meteorological Society, with exchange added for non-Toronto Banks.