Atmosphere

Volume 9 Number 2 1971

Canadian Meteorological Society
Société Météorologique du Canada

Atmosphere

Volume 9 Number 2 1971

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A Brief History of Canadian Meteorological Services Part 2: 1930–1939[1]

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[Manuscript received 31 March 1971]

ABSTRACT

At the beginning of the 1930's the demand for aviation meteorological services was increasing rapidly. Before the Meteorological Service of Canada could significantly expand, however, the economic depression forced the cancellation of contracts and programs in aviation and the demand diminished greatly. Continuing to provide general public and marine forecasts and routine climatological services, the Service inaugurated seasonal forestry and agricultural forecasts during the mid 1930's. Taking advantage of innovations in meteorological science abroad, the Service began participating with the University of Toronto in a post-graduate training program in meteorology, and undertook to adapt the new meteorological theories to North American weather. During the late 1930's the demand for aviation meteorological services intensified again, leading to the establishment of aviation forecast offices to serve Trans-Canada Airlines at Vancouver, Winnipeg, Toronto and Montreal. In addition a trans-Atlantic aviation forecast office was set up at Gander, Newfoundland. During the decade, the number of professional meteorologists in Canada increased from less than a dozen to more than 50, while the number of telegraphic reporting stations was nearly doubled from 70 to 135.

1 A new era

During the decade following World War I many advances were made in meteorological theory and practical forecasting in the Scandinavian countries and Great Britain. Early in the 1930's officials in charge of the Meteorological Service of Canada began to realize that it would be necessary for its officers to understand the new air mass analysis theories and adapt them to North American conditions before any major improvements could be made in the provision of meteorological services. There was, however, a worldwide crippling economic depression during this period and meteorological services in Canada had to be curtailed as the funds available for meteorological expenditures were reduced from $402,000 in 1931 to $297,000 in 1934. Services for aviation were virtually eliminated with the cancelling of inter-city air mail services in

[1]Part 1 was published in *Atmosphere*, **9**, 1–15.

1932, the same year that general meteorological services were discontinued in Newfoundland. Within the Service however, increased attention was paid to training, research, and development, so that by the end of the decade an excellent foundation had been laid upon which the Service would be able to respond to the tremendous demands to be placed upon it by commercial and military aviation.

In January, 1932, Andrew Thomson, a Canadian with considerable meteorological experience in New Zealand and the South Pacific, was recruited and placed in charge of the Physics Division at Headquarters. Several young Canadians undertook post-graduate work in the United States and Europe, with the hope of being employed by the national service upon their return. Others took leave of absence without pay from the Service to study abroad – in 1933 D.C. Archibald, who had joined the Service a few years earlier and had become Superintendent of the Western Airways Weather Service took leave of absence to study in Norway. Also in 1933, the University of Toronto, in conjunction with the Service, established an M.A. course in meteorology and the first graduates – C.C. Boughner, F.G. Millar and M.N. Monsinger entered the Service the following year. Successive post-graduate courses were to produce, over the next few years, a core of professionals around whom it was possible to build a greatly expanded Service during World War II.

2 Research and Development

With the arrival of Thomson in 1932, the Physics Division at Headquarters undertook a daily study of current North American weather maps according to fundamental physical principles and the new methods of analysis and forecasting. These had replaced the older methods of forecasting in the aviation services of western Europe, but there were considerable difficulties at first in applying them to North American conditions. Graduate students in the M.A. course were trained in the new methods and, by 1934, practice aviation forecasts based on the new analysis were being prepared. Lack of data in northern Canada, however, detracted from the advantages of the new system and drew attention to the urgent necessity of establishing more stations in the north, especially in the vast area west of Hudson Bay, if the new methods were to succeed.

Meteorological research was not dormant in Canada during the 1930's. In the 1932–33 International Polar Year program, the Service manned stations at Chesterfield Inlet, Coppermine, Cape Hopes Advance and Meanook for a twelve-month period, during which a series of meteorological and magnetic observations were taken. Several brief popular accounts of Canada's program were written and a complete description of the expedition, with observational data, was published (Canada, Division of Meteorological Services, 1940). In the winter of 1936–37 the Service co-operated with the United States Weather Bureau in special investigations on the properties of cold air masses and 140 special aircraft flights were made at Fort Smith, N.W.T. to obtain upper air data. Water levels in the Great Lakes became a matter of concern during the 1930's,

Dr. John Patterson, F.R.S.C., Director of the Canadian Meteorological Service, 1929–1946.

lake water temperature observations were begun and research was carried out on the measurement and theory of evaporation. Early in the period agriculturalists and entomologists reiterated their need for joint studies with meteorologists on the control of plant diseases, but, unfortunately, little meteorological research was carried out in this field during the decade.

In addition to the research conducted within the Meteorological Service, scientists in associated disciplines were beginning to show interest in meteorology and climatology. Articles were published having to do with hydrometeorology, drought, agricultural meteorology, maritime meteorology, weather periodicities, etc. In particular, N.B. Hatchey, a hydrographer at the Atlantic Biological Station, published several papers during the decade having to do with meteorology, oceanography, and fisheries research. At the National Research Council, J.W. Hopkins became interested in agricultural meteorology and published a dozen papers between 1935 and 1941 dealing with climatic conditions in the grain growing areas of western Canada.

Many scientific improvements and technological innovations were put into use during the 1930's. The telegraph companies replaced Morse code telegraphy with a new teletype system late in 1931, the same year that ventilated psychrometers were introduced. In support of aviation, pilot balloon observations (*pibals*) were begun at several stations in eastern Canada in 1930, but, most of these observations had to be discontinued in 1932. Special aircraft flights, to obtain upper level temperatures and humidity data (*apobs*), were begun on a regular basis at Toronto in 1934, at Edmonton in 1937 and in the same year at Botwood, Newfoundland. Attention was being given to the development of the radiosonde, but not until 1941 did use of this instrument supersede aircraft flights as a means of obtaining upper air data.

3 General forecast services 1930–1939

During the early 1930's the daily public weather forecast continued to be the most important service provided by the Service to Canadians. In 1931 a staff of 10, including 3 meteorologists-in-training, were required each morning in the Toronto Headquarters forecast room to prepare weather forecasts for southern Canada from the Rockies eastward to Newfoundland; while a smaller force of 3 or 4 men was required in the evening for similar work. Daily forecasts for southern British Columbia were prepared and issued by a small staff at Victoria. Surface observational data, taken at 8:00 a.m. and 8:00 p.m., were received in Toronto from about 76 stations in Canada and Newfoundland and from 160 in the United States within 40 minutes after the observation hour; the analysis was then completed and forecasts were issued by 9:40 a.m. and p.m. daily. The Toronto office prepared forecasts for twenty districts and the Victoria office for five. For financial reasons all forecasting for Newfoundland was suspended in 1932, but in 1935 several observing stations were re-opened and the Service began to again furnish forecasts twice a day. In November 1933 the Service undertook to supply forecasts for all Canadian forecast districts to the Canadian Radio Commission for national transmission and broadcasts at 10:35 p.m. EST each day. In addition, local radio stations began to broadcast local, regional or provincial weather forecasts during the early 1930's.

4 Special forecast services 1930–1939

The prime purpose for establishing the Meteorological Service in 1871 had been to issue warnings for mariners on both coasts and the Great Lakes, giving notice of the approach of storms. This service was continued during the 1930's and the Government Marine wireless stations began broadcasting the warnings and forecasts. Although those concerned with agricultural and forestry operations depended largely upon the general weather forecasts, special forecasts for fruit spraying activities were issued during the spring and early summer in some parts of the country. In the spring of 1935 a seasonal office was established at Penticton and a frost warning service inaugurated for the Okanagan Valley of British Columbia. In season a daily forecast fire weather service was provided from Headquarters for Ontario, Quebec and the Maritime provinces and "shippers bulletins" showing temperature, rainfall, wind and weather for representative places across Canada and the United States were prepared daily and transmitted to chief shipping centres.

5 Civil aviation services 1930–1936

Note was made in Part 1 of the special meteorological services provided for the visit of the R-100 to Canada in 1930. In his history of aviation in Canada, Main (1967) remarks: *One notes with astonishment in the records of that period the emphasis laid on the solitary visit of the R-100 rather than on the ground work being laid for the air mail service which commenced the same year.*

The Canadian Meteorological Service did, however, provide general weather forecasts and spot weather information for such air mail routes as an eastern one between Montreal and Windsor and a trunk route on the Prairies between Calgary, Edmonton and Winnipeg. The Service was in the process of establishing several airport offices when the demand for aviation and meteorological services was drastically reduced in 1932 as all inter-city air mail contracts were cancelled by the Post Office. Of the newly established offices, only that at St. Hubert, P.Q., was retained. However, forecasts continued to be regularly provided for scheduled commercial flights between Montreal and Albany and there were numerous requests for special aviation forecasts. In addition, both the St. Hubert office and Headquarters were involved during the early 1930's in providing special weather information and forecasts for long distance flights from Canada to Europe and Asia which were the vogue during this period.

Despite the economic depression, aviation and the supporting services which made this new transportation medium possible, did develop and expand. As part of an economic relief program for unemployed workers, the Government built a number of emergency landing fields in 1934–35 and sixteen of these were later equipped to take meteorological observations. Also in 1934, to meet local demands, aviation forecasts were regularly prepared at Headquarters for Ontario and western Quebec, and a scheduled airway service which required weather forecasts was begun in the Maritime Provinces. Also the network of observing stations was slowly but surely expanding into northern Canada. Although stations were opened at Coppermine, Ft. Norman and Chesterfield in 1930, the depression limited expansion to some fringe area stations such as Fairview, Alta., and Clarke City, P.Q. over the next six years, but a major expansion began in 1937 with the installing of stations at such locations as Port Harrison, P.Q., Arctic Bay, N.W.T. and Fort Nelson, B.C. By 1939 forecasters had telegraphic data available from 275 observing stations in North America and 135 of these were Canadian stations, compared to 70 in 1930.

Prior to 1930, observational data had generally been available only twice daily although some of the new airport stations were providing data and information in the popular "sequence" code a few times each day. Hourly weather observations became generally available throughout the United States in the mid 1930's and by late 1938 such information was to become available throughout the day and night from dozens of airways stations in Canada. In 1936 arrangements were made to have several stations in eastern Canada begin observing and transmitting a third synoptic observation at 2:00 p.m. each day, and by the end of the decade four synoptic observations at 0130, 0730, 1330, and 1930 EST were regularly taken and transmitted from most synoptic stations.

Three members of the forecast staff at Botwood, Nfld. (left to right): J.R.H. Noble, Dr. P.D. McTaggart-Cowan, H.H. Bindon.

6 Professional staff in 1935

It is interesting to note that as late as 1935 the professional strength of the Meteorological Service of Canada was overwhelmingly concentrated at the Toronto Headquarters. There were meteorologists at Victoria (F.N. Denison) and Winnipeg (A.R. McCauley) but senior meteorological technicians were in charge of the observatories and offices at Quebec (M. Royer), Saint John, N.B., (F.M. Barnes), Montreal/St. Hubert (J.F. Carmichael), and Vancouver (E.B. Shearman). The Quebec office was primarily an observing post, but Vancouver served both the public and shipping and the St. John Observatory provided extensive services to the public. In 1931 there had been offices at both the Grain Exchange and the airport in Winnipeg, but with the curtailment of the Prairie air mail service the airport office was closed and the meteorologist moved to the downtown office. Meteorologists at Headquarters in 1935 included Patterson, Thomson, Connor, Boughner, Archibald, Middleton, Jacobsen, McPherson, Troop, Chisholm, Millar, Monsinger and in the Forecast Office, O'Donnel, Fox, Chilcott and Thorn.

Joint Meeting of Royal Meteorological Society and American Meteorological Society, Toronto - August 28-29, 1939

Back row (l to r): G Emmons, **Ralph Anderson**, **Don S Ross**, **J Hank Sabraw**, JC Hagan, **WE Knowles Middleton**, **Abraham (AJ) Connor,** CG Andrus, W Reed, H Solberg, AT Doodson, SS Schworm, **Ratje (RC) Jacobsen**, CJ MacGregor, **L Gilchrist, Harvey W Halbert.**

Middle row: Miss KM Ellis, **F Graham Millar**, **Arthur S G Grant, Jim M Leaver, Don McIntyre**, DE Newton, **E Wendell Hewson,** Bernhardt Haurwitz, **Don C Archibald**, JO Wilhelm, **Balfour W Currie, Clarence C Boughner, Murray N Monsinger, RT Zoch, Alvin D Thiessen, Andrew Thomson**, WN McLean, Mrs B Haurwitz, **GM Schrum** (behind Mrs. Haurwitz).

Front row: **EF Burton**, VW Ekman, HR Byers, Jacob Bjerknes, David Brunt, CF Brooks, Sidney Chapman, **John Patterson**, FW Reichelderfer, Fred JW Whipple, Sverre Pettersen, WM Elsasser.

(Canadian delegate names are in **bold**)

7 Trans-Atlantic services 1935–1939

At an Ottawa international conference convened in 1935 to arrange the necessary meteorological services for experimental flights across the North Atlantic, Canada assumed responsibility for weather information and forecasts for the area extending from Montreal through Newfoundland to 30° west longitude in the mid-Atlantic ocean. Supporting services were organized in 1936 and the first experimental flights were carried out in 1937 after a meteorological office had been installed at Botwood, Newfoundland and the St. Hubert office upgraded. One of the most active participants in developing the Newfoundland services was P.D. McTaggart-Cowan, a Canadian Rhodes Scholar who studied meteorology in England before returning to Canada. He quickly became the ranking expert on North Atlantic meteorology and aviation forecasting and later served as Director of the Meteorological Service of Canada. An account of trans-Atlantic aviation and meteorology published by McTaggart-Cowan (1938) is a most valuable record of the developmental work carried out the previous year. It is perhaps interesting and significant to note that the three most recent Directors of the Service – Dr. A. Thomson, Dr. P.D. McTaggart-Cowan, and Mr. J.R.H. Noble, were active participants in launching the pioneer trans-Atlantic aviation service in Newfoundland during this period.

Trans-Atlantic flying boat experimental flights were made in the summers of 1937 and 1938 by Imperial Airways and Pan American Airways and in the summer of 1939 about 50 round trips were made, carrying both passengers and mail. The Weather Office was moved from Botwood to Gander Airport and by 1939 the staff consisted of 4 meteorologists and 11 assistants. The Gander Office also issued public weather forecasts and storm warnings for the Newfoundland area. By the end of the 1939 season, however, with the outbreak of war, there was some uncertainty as to the immediate future of civil aviation and meteorology in Newfoundland.

8 A new department

A major result of planning that had been underway in the mid 1930's for domestic aviation in Canada was the establishment of a new Department of Transport in November 1936. Attached to the Marine Department since its formation, the Meteorological Service of Canada now became the Meteorological Branch of Air Services of the new department. In this re-organization the Meteorological Branch was freed both of those ancillary responsibilities which it had carried since 1871 and of others which it had developed during the intervening 65 years. Some of the resources of the Service had been devoted to observations and research in terrestrial magnetism and astronomy and in the provision of a time service at several locations across the country. Meteorologists had also been responsible for seismological observations at Toronto and Victoria and, in the early years of the Service, had conducted hydrographic surveys. All of these responsibilities were transferred to agencies in the Department of Mines and Forestry. The Meteorological Branch was now free to devote its efforts to providing a better weather service for Canada.

9 Civil aviation services 1937–1939

With the establishment in 1937 of Trans-Canada Airlines (as the present Air Canada was called until 1965), the new Meteorological Division acquired tremendous responsibilities and challenges. To service the meteorological requirements of TCA the Division would have to establish several forecast offices at TCA divisional headquarters, provide meteorological staff at many of the intermediate airports and operate a 24-hour service. More frequent observations at an increased number of off-airways observing stations would be required. It would also be necessary of course to connect all forecast offices and airports with a leased teletype system. The airlines began local services in western Canada late in 1937, by June 1938 passenger service had been extended to Toronto and Montreal and finally, the trans-continental link was made when flights began to Moncton in September 1939.

Fortunately, and as a result both of good planning by the Meteorological Service and the depressed economic conditions of the country, the University of Toronto post-graduate course in meteorology had attracted a few dozen bright mathematics and physics graduates from 1933 to 1937. By recruiting and training these men the new Meteorological Division was able to establish and staff aviation forecast offices at Vancouver, Winnipeg, Toronto/Malton, Montreal/St. Hubert and for trans-Atlantic purposes, as mentioned previously, at Gander, Newfoundland. In addition, many new meteorological assistants were recruited, trained and posted to the forecast offices and to half a dozen intermediate airports.

10 Climatological services 1930–1939

With the increased attention to new theories and techniques in meteorology and particularly to aviation forecasting, climatological services became somewhat neglected and inadequate during the 1930's. The provision of climatological data and information, of course, pre-dated the provision of forecast services, and the Service continued to collect, process and publish historical climatological data. In 1931 data were published for approximately 750 stations in the *Monthly Record* and the *Monthly Weather Map*, and in various federal and provincial year books. The number of climatological stations in operation during the decade varied from 750 to about 900 as the economic situation precluded any significant expansion in this area. At Headquarters, about 1,000 special requests for information regarding the climate of Canada were answered each year while a considerable volume of this kind of work was handled at other offices, notably Victoria and Saint John. An innovation in 1936 was the preparing and publishing, during the growing season, of a weekly weather summary for the grain area of the Prairie Provinces.

Meteorological agents in Victoria, Edmonton, Moose Jaw, and Saint John supervised the cooperative climatological observers in their respective areas of the country. Observers in Manitoba and Ontario corresponded directly with Headquarters, while the Quebec Streams Commission cooperated with the federal department by supervising climatological stations in that province.

A.J. Connor, who was then known as the Dominion Climatologist, was responsible for the preparation of considerable statistical climatological data and the publication of reports and articles dealing with climatic conditions in northern Canada and the Prairie Provinces. Also during this period he prepared a major report on the climate of Canada for the Köppen-Geiger *Handbuch der Klimatologie* (Connor, 1936). An American graduate student, C.E. Koeppe (1931) published a thesis entitled *The Canadian Climate* – the first, and to this day the only book devoted to the climate of the country.

11 Services for the Armed Forces

Prior to 1939 the Royal Canadian Air Force had not expressed a need for any regular, full-time meteorological service. Annual meetings and visits had taken place between Headquarters meteorological personnel and RCAF officers but it was not until late in 1938 that the RCAF requested regular forecasts and professional services for their units. At the outbreak of war in September 1939, one meteorologist and one assistant had just been posted with the RCAF at Vancouver, the first direct involvement of civilian meteorological personnel with the military in Canada. The meteorological requirements of the Royal Canadian Navy in the 1930's were limited to forecasts and information which were prepared in Toronto and forwarded to Halifax for radio broadcast to vessels at sea during the summer season. The requirements of the Canadian Army were apparently minimal and no special services had been requested prior to 1939, when operational advice for artillery units was requested.

12 September 1939

On September 1, 1939, just before the outbreak of war, the total Canadian meteorological establishment consisted of no more than 51 graduate M.A. meteorologists, 20 meteorological assistants corresponding in some respects to today's B.A. meteorologists, 57 meteorological observers, 26 teletype operators and 59 administrative and clerical personnel. While this was a major expansion in comparison to the size of the staff in 1931, and even in 1935, the next few years were to see an almost ten-fold expansion.

In addition to those at Toronto, professional meteorologists were now stationed at 11 other locations across the country and a single teletype circuit extended from Moncton, N.B., to Vancouver, B.C., with a sub-extension from Lethbridge to Edmonton in Alberta. The Canadian meteorological circuit was connected with the U.S. Weather Bureau teletype circuits by ties from Vancouver to Seattle and Toronto to Buffalo.

The traditional public weather forecasts were still being prepared by the old methods and provided from Toronto and Victoria for southern Canada, but trans-continental aviation forecast offices had just been opened and developmental work had shown that trans-Atlantic aviation weather services were not only feasible but essential. Special forecasts for agriculture and forestry had become regular seasonal features, but climatological services to provide information and data were somewhat restricted by lack of resources.

At a joint meeting of the Royal Meteorological Society and the American Meteorological Society in Toronto late in August, 1939, the Controller of the Meteorological Branch, Mr. John Patterson (1940), presented an address titled *A Century of Meteorology* in which he concluded with the words: *For you young men who are just entering the Service there is a very great future in meteorology. ... Of all sciences, meteorology will probably make the greatest advance in the next hundred years. This then is your opportunity.*

Most of the meteorologists who heard John Patterson were unaware of how firmly the Meteorological Division was tied to commercial and military aviation and how radically any event which affected aviation would also affect meteorology. Within a few days war was to break out in Europe; Canadian aviation was about to be asked to undertake programs not dreamed possible that August. And meteorology in Canada, about to be so necessary to the progress of the British Commonwealth Air Training Plan, was to expand by a whole order of magnitude.

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500-Millibar Prediction by Statistical Methods

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[Manuscript received 17 November 1970]

ABSTRACT

Sets of multiple-regression equations are proposed as a statistical *"model"* for the three- to six-day prediction of broad-scale height patterns at 500 millibars. Verification results suggest that such a model may have a use both in operational forecasting and as a tool in further investigation into extended-period trends in the mid-troposphere.

1 Introduction

In spite of the rapid and continuing growth in the field of numerical weather prediction, forecasts of the basic mid-tropospheric flow (i.e., at 500 mb) at present tend to deteriorate markedly after three to four days. Improved observations and further sophistication of the atmospheric models employed will extend this period outward, but may reasonably be expected to require increased computer capacity and/or computing time.

For time periods at which production costs outweigh forecast skill (i.e., usefulness), the integration of numerical models of the atmosphere becomes operationally unprofitable, and the largely deterministic approach represented by their simulation of physical laws must be replaced by predominantly statistical or subjective methods.

The assumption of persistence, or an appeal to climatological averages, represents very simple methods of "prediction" in the extended-time range. More meaningful forecasts may be attempted by the use of space-time relationships suggested by the crude application of the physical laws, by reference to the behaviour of NWP models under similar flow conditions, or by the examination of events following analogous conditions in the past.

This paper outlines a method based on the concept of hemispheric teleconnection (O'Connor, 1969). The simple statistical model which is derived is used to predict areal height averages at 500 mb for a set of regions in the northern hemisphere, and by so doing, to define a broad-scale flow pattern which is the most probable consequence of a given initial state.

Forecasts made by the model are compared with those based on persistence and climatology.

2 Derivation of model

Five years of computer-analysed 500-mb height data were available as input in the determination of the sets of multiple-regression equations which make up the model.

Height values originally given for points on the operational USWB grid (grid-length 381 km) were transformed into a set of 44 new variables, representing the simple arithmetic means of heights in an array of non-overlapping 5 × 5 grid squares. The area covered by this set of means, while only a little more than half that of the original analysis, nevertheless includes virtually all the hemisphere north of 30–35N, and thus contains the region of major day-to-day change at the 500-mb level.

The density of information is sufficient to permit definition of the flow pattern to wave number five or six at mid latitudes. This degree of definition, while inadequate for the time and space precision expected of short-range forecasts, can provide the extended-range forecaster with useful indications of parameters such as mean storm tracks, and allow the specification of consequent weather regimes over given areas.

The hypothesis that the height Z_j over a given grid area j is dependent on the height pattern D days earlier may be expressed by a linear regression equation

$$(Z_j - \bar{Z}_j)_{\,t\,=\,D} = \Sigma_i\, a_{ij}(Z_i - \bar{Z}_i)_{\,t=0}$$

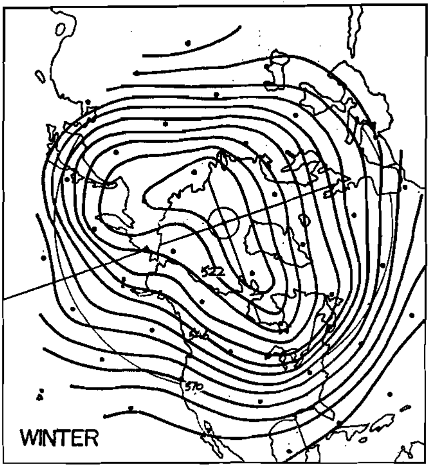
where the barred quantities are time means for the period over which the equation applies, and the a_{ij}'s are constants derived from a correlation matrix and the ratio of the standard deviations of Z_j and Z_i.

Equations of this type were derived for each of the 44 transformed variables for each of four seasons, each equation depending on approximately 400 days of observation. A time lag D of three days was used, in part for comparison with available barotropic forecasts, and in part because either iteration or use with the barotropic forecast as input would provide a feasibility test for the 3–6 day forecast period.

For strictly predictive purposes, a relatively small number of terms on the right side of the equations can account for all but a small part of the explainable variance of the predictand. To be able, however, to make visual comparisons between areas and between seasons, and to obtain at least qualitative information as to mean wave patterns and displacements, all 44 possible predictors were used in each equation.

3 Description

Examples of the seasonal means and standard deviations which were used in determining the constants of the equation sets are given in Figs. 1–2. Contours are drawn on the basis of hand interpolation from the set of values obtained at locations marked by dots. Though no strict comparison can be made with long-term mean charts, the circulation patterns obtained are sufficiently similar to



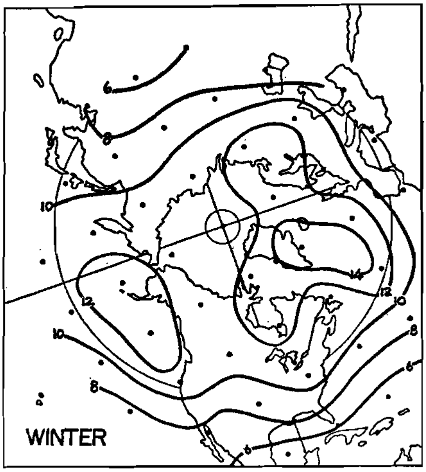
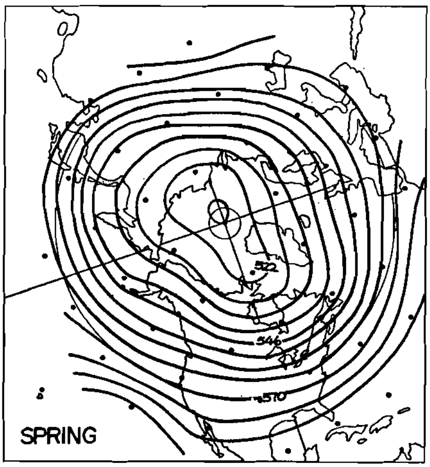
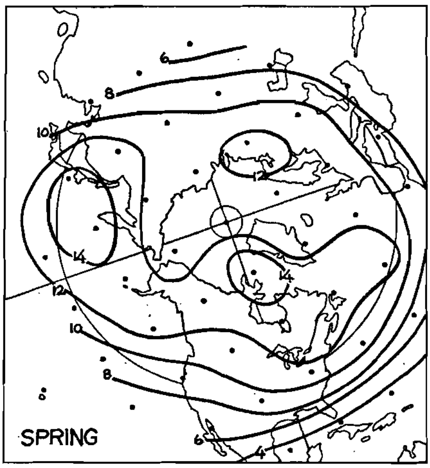


Fig. 1 Mean 500-mb height (dam) for period 1962–1966. (Contours by interpolation from area averages centred on grid-points indicated by dots.)

Fig. 2 Standard deviation of 500-mb area-average heights (dam) for period 1962–1966.

Winter (Dec-Jan-Feb) Spring (Mar-Apr-May)





climatological patterns to suggest that the five-year period of observation used was a reasonably representative one.

For particular gridpoints P, hand interpolation of a_{iP} $(i = 1{,}44)$ yields the visual representation of the corresponding regression equations. Figs. 3–4 show the dependence of height anomaly on initial pattern for Baffin Island and the central USA, for the four seasons. Total correlation coefficients for the two areas are typical of the values obtained. They varied from a minimum of 0.60 off Newfoundland in winter to a maximum of 0.95 over central Asia in autumn.

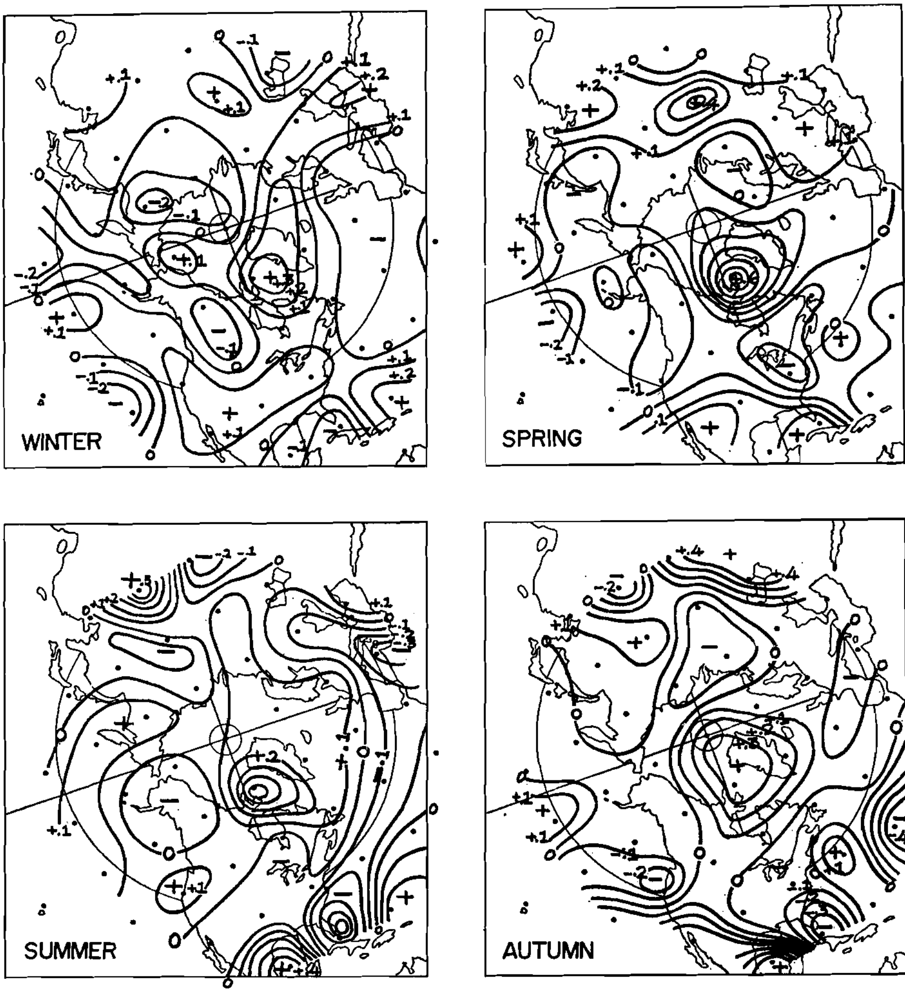


Fig. 3 Regression coefficients of area height anomalies (dam) for 3-day prediction of anomaly centred on Baffin Island. (Contours by interpolation from values at 44 grid-points indicated by dots.)

Averages were 0.74 in winter, 0.84 in spring, 0.77 in summer and 0.84 in autumn.

The patterns of regression coefficients in Fig. 3 are typical of those obtained for Arctic regions. Coefficients at low latitudes are inflated by the ratio of the standard deviations which is contained as a factor. For all four seasons, positive coefficients are found immediately east of the area, negative ones to the west, indicating the dominance of broad-scale retrogression at high latitudes. In most cases, a second region of positive coefficients is found at the same latitude on the opposite side of the pole, suggesting that the retrogression is primarily associated with wave number 2. In most cases, also, a meridional wave pattern is

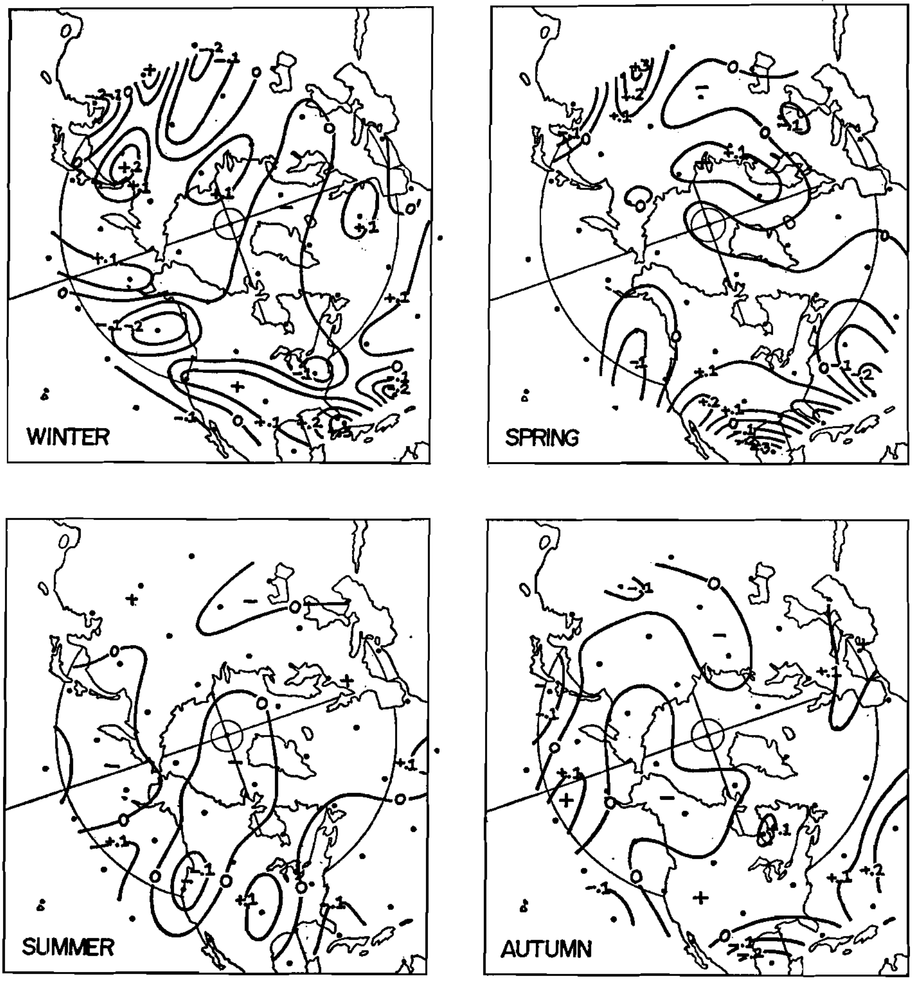


Fig. 4 Regression coefficients of area height anomalies (dam) for 3-day prediction of anomaly centred over central USA.

suggested. For Baffin, in all seasons except winter, positive values over the pole, coupled with coefficient minima over central Siberia and James Bay – eastern USA, point to a southward moving wave of length 70–75 latitude degrees.

At mid latitudes, patterns tend to be more incoherent, both as between areas and between seasons. Nevertheless, important wave motions can usually be identified. For the central USA, for instance, (Fig. 4) it can be hypothesized that the summer pattern of a minimum on the West Coast and maxima over the central USA and the east-central Pacific represents a very slow-moving wave with a wave number equal to six. In winter, the summer minimum is shifted to the east-central Pacific, the maxima towards the West Coast and to just east of the date line, maintaining the same wavelength, but now suggesting a progres-

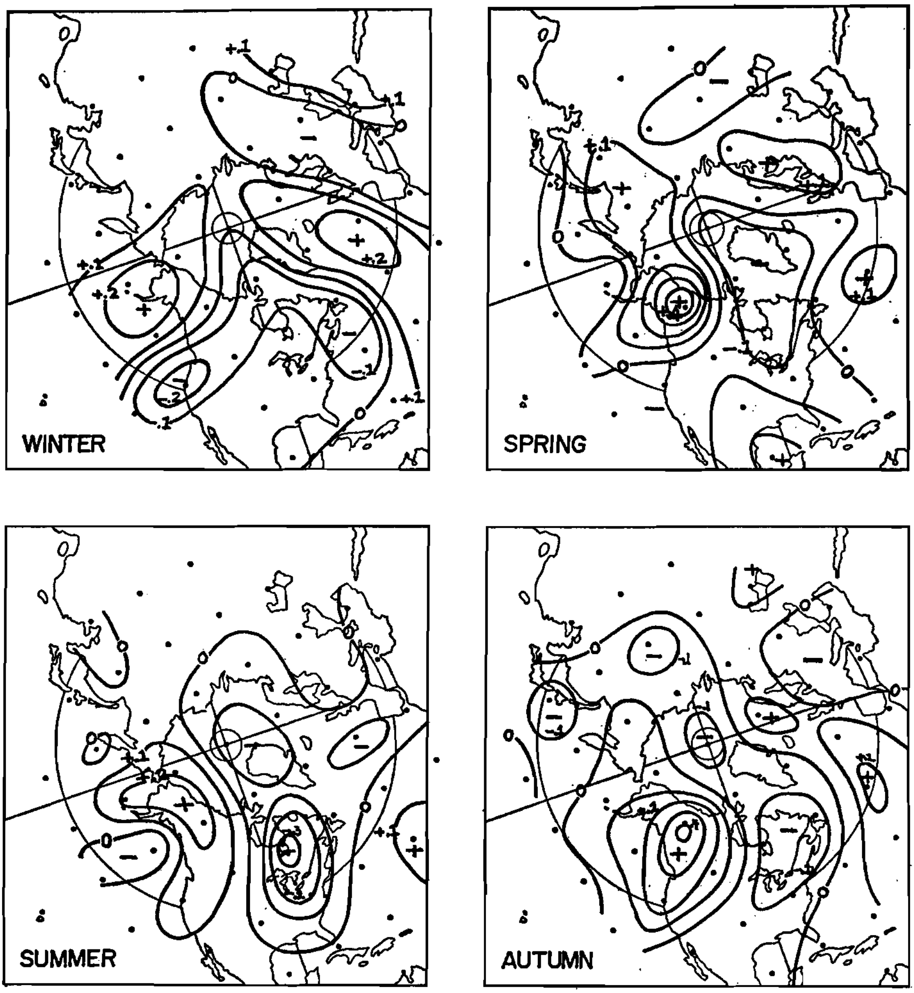


Fig. 5 3-day prediction of area-average height anomalies (dam) for initial mean heights perturbed by 1-dam anomaly over northwestern Canada.

sion of about 20 latitude degrees per three days. Spring and fall patterns lie between the two extremes.

The interaction of height anomalies may also be studied by posing arbitrary initial conditions and observing the predicted patterns. One simple assumption for initial conditions is that $Z_i = \overline{Z}_i$ everywhere except at point P, where $Z_p - \overline{Z}_p = 1$. The coefficients a_{pj} ($j = 1,44$) then provide the predicted anomaly pattern (Figs. 5–6) which may be considered the result of a perturbation superimposed on an otherwise undisturbed mean flow.

As might be expected, Figs. 5–6 show much the same features as the preceding charts. Thus at high latitudes, initial perturbations tend to move westward,

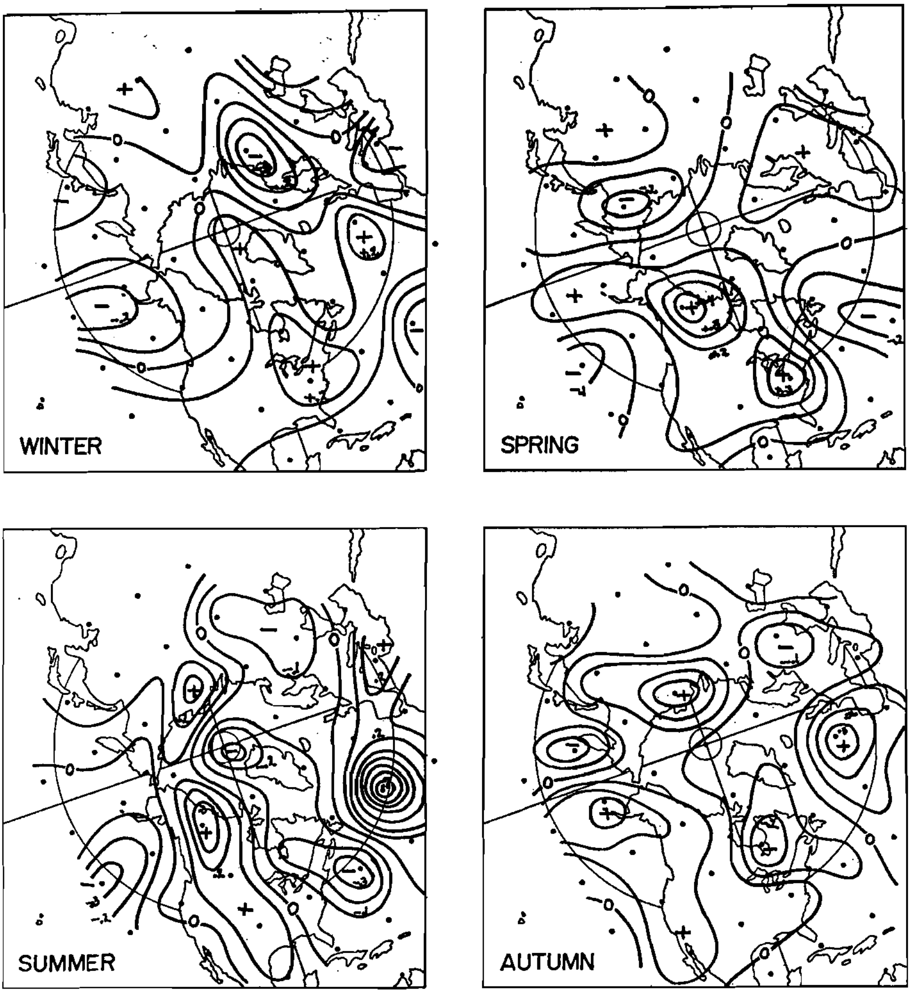


Fig. 6 3-day prediction of area-average height anomalies (dam) for initial mean heights perturbed by 1-dam anomaly over central USA.

while at the same time inducing a wave pattern of about 90 long. degrees length in the zonal direction. A winter perturbation in the central USA results in anomaly maxima on the east coast of the USA and over the eastern Atlantic, again indicating the development of wave number 5–6 and its progression at about 20 degs. per three days. In summer, the same wave is induced but remains stationary.

More complex anomaly patterns as initial input can be used to represent other idealized flow patterns. For instance, Fig. 7 gives anomalies corresponding to a circular flow pattern centred on the autumn pole, with weaker than normal westerlies between the pole and 50N and stronger than normal westerlies in the band 40–50N. The predicted circulation three days later (Fig. 8) shows only a

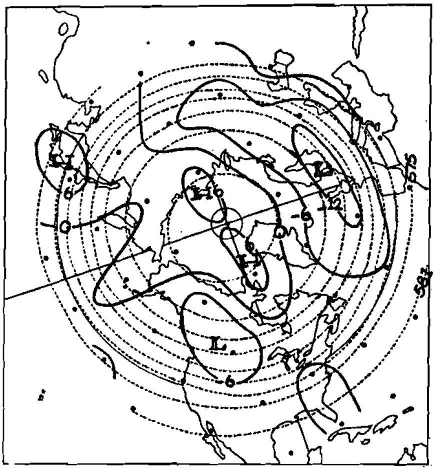


Fig. 7 Hypothetical height (dashed lines) and anomaly (solid lines) patterns for Autumn.

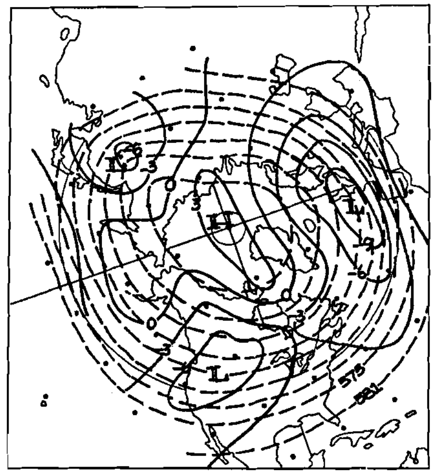


Fig. 8 3-day prediction of height and anomaly patterns from initial state shown in Fig. 7.

slight weakening of the anomaly pattern from North America to Europe, but significant changes over Asia and the western Pacific, where the signs of the initial anomaly centres are reversed.

4 Verifications

To test the validity and usefulness of the equations, independent data were extracted from operational 500-mb analyses during 1969 and used as input. The 3-day statistical forecasts are compared with:

1) Persistence
2) Seasonal mean
3) Barotropic 72-hr forecast.

For forecast periods of six days, both the 3-day statistical and barotropic prognoses were used as input, and the results compared with persistence and the seasonal mean, as well as simple persistence of the 72-hr barotropic forecast.

Treating each of the 44 anomalies as separate predictands for each of the days tested, a grand total of some 3000 forecasts produced the Root Mean Square Errors of Table 1. These figures suggested slight overall skill with respect to both persistence and the seasonal norms, and only mildly inferior results compared with those obtained by the barotropic prognoses. The loss to persistence at three days in winter is in a measure compensated by the win over the barotropic at three days in spring. The use of monthly or daily normals, especially in spring and fall, would give lower errors than the seasonal means used here, but examination of the relatively small number of cases when the three are almost identical suggests that the ranking of results would remain unchanged.

TABLE 1. ROOT MEAN SQUARE ERROR (dam)

	3-Day				6-Day				
	P	S	B	C	P	SS	SB	PB	C
Winter (15 days)	8.78	9.28	8.10	11.04	11.12	10.29	10.87	10.89	11.04
Spring (23 days)	8.54	7.63	7.79	10.41	10.90	8.55	8.58	10.35	10.25
Summer (28 days)	5.64	5.53	4.90	6.87	6.77	6.07	6.08	6.83	6.81
Autumn (24 days)	8.20	7.52	6.63	9.61	9.88	8.00	8.48	9.47	9.47
TOTAL (90 days)	7.70	7.34	6.75	9.34	9.56	8.06	8.32	9.26	9.25

TABLE 2. AVERAGE CORRELATION COEFFICIENT

	3-Day				6-Day				
	P	S	B	C	P	SS	SB	PB	C
Winter	0.672	0.559	0.752	0.0	0.480	0.371	0.422	0.532	0.0
Spring	0.504	0.468	0.590	0.0	0.210	0.245	0.322	0.261	0.0
Summer	0.555	0.406	0.672	0.0	0.388	0.165	0.273	0.274	0.0
Autumn	0.465	0.412	0.663	0.0	0.243	0.243	0.259	0.329	0.0
TOTAL	0.537	0.449	0.662	0.0	0.319	0.241	0.307	0.328	0.0

P—persistence S—statistical B—72-hr barotropic C—seasonal mean
SS—statistical input to statistical forecast
SB—barotropic input to statistical forecast
PB—persistence of 3-day barotropic

If, on the other hand, the correlation coefficient between 44 predicted and 44 observed anomalies is computed for each day's forecast, average values (Table 2) show the statistical model to be less satisfactory for the prediction of flow *pattern* as opposed to absolute height values. The positive values for the statistical prognoses still indicate skill relative to the seasonal normals, but except for spring 6-day forecasts, are inferior to persistence scores, as well as to those derived from the barotropic predictions.

5 Conclusions

The verification results suggest that the equations making up the statistical model are at least qualitatively valid, and that the model could be a useful tool in the further exploration and understanding of normal wave patterns and their evolution. The operational value of the model in its present form is limited, but in conjunction with subjective methods, it might nevertheless be a useful guide for periods of up to 3–6 days when other numerical predictions are unavailable, or in assessing the relative merits of other computer-produced forecasts.

Modification of space and time scales, and consideration of non-linear terms and outside predictors (such as sea-temperature anomalies) provide avenues for the future improvement of the model, and might well produce quantitative results competitive with other forecast methods.

Acknowledgements

The writer owes much to the advice and encouragement of Mr. D.E. McClellan and others on the staff of the Extended Forecast Unit, Central Analysis Office, Atmospheric Environment Service, Montreal.

He is especially indebted to Mr. André Jacques for the preparation of diagrams and to Mrs. Margaret Armstrong for the typing of the manuscript.

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MASON, B.J., 1970: Future developments in meteorology: an outlook to the year 2000. *Quart. J. Roy. Meteorol. Soc.*, **96**, 349–368.

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CALL FOR PAPERS – SIXTH ANNUAL CONGRESS

The Sixth Annual Congress and Annual General Meeting of the Canadian Meteorological Society will be held at the University of Alberta, Edmonton, Alberta, May 31–June 2, 1972. Although the theme of the Congress and the session topics are not yet decided upon it is expected that papers will be acceptable on a wide range of meteorological subjects.

Members and others wishing to present papers at these meetings should send titles and definitive abstracts (preferably less than 300 words) to the Program Chairman, Professor K. D. Hage, Department of Geography, University of Alberta, Edmonton 7, Alberta.

The Local Arrangements Committee is already hard at work under the direction of A. F. Ingall of the Edmonton Centre, and information regarding registration, activities etc., will be provided as arrangements proceed.

STATISTICS IN THE COMPUTER AGE. By J.M. Craddock, English Universities Press, London (handled in Canada by the Musson Book Company, Don Mills, Ontario), 1968, 214 pp., $6.30.

According to the General Editor, Sir Graham Sutton, the *New Science Series* to which this book belongs is aimed specially at the younger generation but "will be of interest and value to more mature minds". Because of numerous printing errors and because of oversights in some of the display material, the primary objective may not be achieved. However, I feel that the book could serve an even more useful purpose. There is a large number of scientists and engineers making use of statistical procedures without much in the way of formal training in the subject. This means that many do not have an appreciation of the implications of their choice of procedures or the results they present. This book could help to correct the situation.

There can be no question of the credentials of either the author or the editor. Mr. Craddock is a well-known scientist of the British Meteorological Office, and O.G. Sutton certainly requires no introduction either. It is a shame that the technical quality of the printing doesn't measure up to either the illustrious names involved or the quality of the presentation.

Mr. Craddock states in the Author's Preface that he is trying "to explain something of the methods of statistics, and of the objectives and processes of thought of statisticians, which are relevant in the age of the computer". He proceeds to explain that he will aim at those who are interested in the results of statistical inference, rather than "in either the collection of dead figures, on one hand, or the elegances of statistical mathematics on the other". Many persons who fall into this target category can benefit from reading this book.

In the Introduction, statistics (and statistic) are defined, their place in science is outlined, preliminary ideas on the collection of data and the development of mathematical models are presented, and the picture is tied together by sections on the part played by statistics and the overall plan of the book. This is followed by a brief but interesting presentation of the historical background in Chapter 2. Chapter 3 discusses descriptive statistics and simple methods of expressing and displaying the variability of data.

Thereafter, the material expands to probability (including a discussion of randomness) populations and samples thereof, and probability generating functions. This leads to "Drawing Statistical Inferences" in Chapter 5, and the binomial, Poisson and Gaussian distributions, which are followed by a discussion of significance and the t-distribution. Then the relations between two or more variables are introduced, along with the chi-square distribution, the F-test and additional analyses of variance.

Chapter 11, "Statistics and the Electronic Computer" provides a break that could well be skipped by many readers. The outline of unit-record equipment, leading to a description of input/output apparatus and "computer languages" would suit a primer on computers, but add little to the other material being presented in this book.

Following this interlude, Mr. Craddock launches into a further discussion on the use of random numbers, then, in chapter 13, introduces the concepts of the analysis of time series which leads to the power spectrum and filtering.

The amount of detail presented in these discussions is insufficient to permit the book to be used as a "cookbook". There are no recipes for potential users to follow. To me, the real value comes in the philosophy, if you will, back of the concepts or processes.

Major criticism must be made of the printing. The problems range from outright errors that should have been detected in the proofreading process, to confusing print. As an example of the latter,

$$Vx + y = Vx + Vy$$

appears on page 28. This makes little sense until one recognizes that the lower case letters are subscripts. Since subscripts are more obvious elsewhere in the book, it is a pity that the proper practice was not more consistently followed.

The errors are more serious. The expression for covariance on page 28 contains an overbar on x_j that doesn't belong. On page 41, the quantity $1-r_y{}^2$ *should be* $1-r_{xy}{}^2$. In table 6 on page 72, the frequency of the class $n = 2$ is 2, not 22 as stated. Equation 39 on page 104 is a complete disaster. Even the chapter titles at the top of the right-hand pages have occasional spelling errors.

An equally serious problem comes with some of the display material; these oversights should have been caught in the review of the original manuscript. The most obvious case is Table 2 on page 30. Not only is n multiply defined (as the class number in the heading of column (c), and as the total number of data, Σf) but Σx^2 is stated to be Σnf^2 (the first of the n's) rather than $\Sigma n^2 f$. Pity the poor novice who is following the definition of the mean, $\bar{x}$, as $\Sigma x/n$ (the second n) which, from the line above could be expressed as $\Sigma nf/n$, where the n's are different.

Table 4 on page 42 improves on table 2 by calling one of the n's "Tot", but I feel that insufficient description is provided for the contents of the boxes. The reader can deduce, only with some difficulty, what the various numbers are or how they are derived, but the necessity for doing so is a needless distraction. Much less critically, I feel that the meaning of $(°F)^2$ is much clearer than $°F^2$ which is used in both tables.

Other signs of omission that could be mentioned are: the insufficient content of the set of equations (45) on page 160 to allow their pattern to be deduced easily; and the failure to identify the dots and crosses in figure 11 on page 188. Finally, it was most confusing to read (page 124) of "m plants of each of n varieties" from which "... we make up n sets of plants, each set containing one plant of each variety."

In summary, I cannot say whether or not the book hits the targets at which the author and the editor were aiming. It should, however, be a part of the library of any institution at which those who are not specialists in statistics make use of statistical procedures. It should be suggested to such persons that they read and digest the portions of this book that deal with the particular procedures they use. In any event, I hope that the next edition of the book, should one be necessary, corrects some of the shortcomings described above.

J.A.W. McCulloch
Atmospheric Environment Service
Toronto

THE GOOD, GOOD EARTH: OUR FIGHT FOR SURVIVAL. By R.O. Brinkhurst and D.A. Chant. MacMillan of Canada, Toronto, 1971, 174 pp., $6.95.

This book on pollution has been written for the layman by two professors in the

Department of Zoology at the University of Toronto. The authors also have been very prominent in the activities of *Pollution Probe*, a citizens group.

The book is highly recommended for all those who enjoy science fiction: I am appalled, however, that the book is being offered to the Canadian public as a serious commentary on environmental problems. The authors have in fact presented us with a collection of platitudes, exaggerations, half-truths and errors. Their special targets are the Judaeo-Christian tradition (the basic cause of pollution, we are told!) and the government scientist, who should resign if he has any principles at all!! This latter point of view may be illustrated with a few quotations:

> "Unfortunately, the objective detachment of the government scientist may be hindered by the political necessities of his paymasters."
>
> "The terms of employment in a particular government agency may be quite unacceptable to the most highly competent scientists."
>
> "A sure way to impress a bureaucrat at budget time is to show him reams of data."

The academic scientist, on the other hand, is criticised for not seeking out the press and T.V. He should put his case to the public. "To do this, extreme tactics are necessary – confrontation, antagonism, simplification and dramatization." These comments represent a point of view that I cannot accept.

The authors frequently err in their discussions of air pollution and atmospheric problems. The CO_2 concentration is given as 316 parts per trillion instead of per million. They are not aware of the fact that oxygen depletion is now considered to be a non-problem. Their discussion of climatic change ends with the absurd rhetorical question: "Who is bothering to think about these things in relation to the abundance of man?" Thermal pollution is described as a major threat to mankind. "A waste heat loss of only one per cent of the incident radiation, or about twice the present level, would be catastrophic." Contrast this statement with the findings of the SCEP (Study of Critical Environmental Problems) Workshop held in July, 1970.* "Although by the year 2000, global thermal power output may be as much as six times the present level, we do not expect it to affect global climate." Although the authors' predictions throughout the book may occasionally prove to be right, the point to be made is that Professors Brinkhurst and Chant are seriously misleading the layman by ignoring the concensus of present scientific opinion.

R.E. Munn
Atmospheric Environment Service
Toronto

**Man's impact on the global environment.* The MIT Press, Cambridge, Mass. (1970).

CORRESPONDENCE

What is Our Purpose?

Well, the bad news is out – subscriptions to the Canadian Meteorological Society are to increase by 75% to $14, starting in 1971. As a member who will have to pay this increase if he remains in the Society, I think we should all take a close look at the functions of the Society – whether its stated aims are desirable, how they should be interpreted, and most of all, whether the Society is doing, or can do, anything effective to carry them out.

To start with, we should question the purpose of meteorology, or for that matter, any science. I am something of a heretic amongst scientists. There are some who make a god of research; perhaps as a result of "publish-or-perish" pressure, or the need for security of employment, they rationalize that all research is unquestionably desirable and good, and therefore any project deserves the support of public funds. Having got the funds, they have to be spent at all costs, otherwise more money won't be forthcoming in a future year. Indeed, this attitude is encouraged by the practice of measuring the prestige of a scientist by the size of his research grant. He is judged by what he receives from society rather than what he gives, by the cost of his project rather than the social and scientific value of his results. (But is it true that the greatest discoveries in science have resulted from the most expensive projects?)

From this point, it is a short step to the dogma that it is man's duty to serve science. My own view is that it is science's duty to serve man. Perhaps I am cutting my own throat by saying this, but I am not ashamed of it, and I think a few more scientists should have the courage to do likewise. I do not deny that science is useful, and, of course, interesting in itself, and indeed does serve a few people by satisfying their curiosity and providing employment. But must this curiosity be satisfied regardless of the consequences to man and beast? I do not acknowledge science as a soulless god, to which all other needs of society, and other aspects of one's personal development, should be sacrificed.

Applying this philosophy to our Society, we must ask what is meant by "the advancement of meteorology", which is stated to be the reason for the Society's existence. Is this something which is achieved by holding monthly social meetings in certain centres? Does it imply the addition of more journals to the "paper explosion", which eventually threatens to smother Canada with pulp mills, so that the air reeks of mercaptans from sea to sea? Does it merely mean doing something to improve the lot of the professional meteorologist? Or does it imply a service to the community as a whole, by making the people aware of how meteorology can benefit them, and helping them to understand the subject?

When I first joined the Society, I rather naively assumed that the last of these alternatives applied, and considered how I myself could contribute something towards that goal. I thought I might be able to help by giving a short summer field course in meteorology. In Britain, the Royal Meteorological Society has sponsored such courses successfully for several years, and indeed had eight such courses planned for 1970. So I put this idea to the C.M.S. Executive, and received in reply several questions asking for more details. To my amazement, one of these questions was "What would be the advantages to the Society?" To that, I was strongly tempted to reply "What good is the Society, period?" However, I resisted this temptation, and instead submitted some more constructive proposals, including the offer of my own services as instructor without remuneration if the course was given in 1970, plus a request for constructive suggestions from the Society or elsewhere, but no request for money. The final outcome was a statement to the effect that since the Society could not provide financial help, it was not prepared to give any other help either.

I think it is unfortunate that people in this country are so obsessed with money. There seems to be a feeling that if a person has troubles, they can only be financial ones, that if someone asks for help, then it means he is asking for money, and that a few more dollars will solve everyone's troubles. Possibly I am exceptional, but I have found that this is not always so. Taking as an example the case of a field course, this could be held on a trial basis at negligible cost, given the services of a volunteer instructor for a few days, plus the offer of some classroom space and the loan of some very basic and simple equipment (e.g., thermometers) from a local educational institution. Students would then be faced with little more than expenses for travel, room and board and notepaper.

To give another example, I was once in the position of having funds for research, but yet was severely hampered by the refusal of other people to even discuss projects with me.

I personally think that the Society's task should not be to amass wealth, or to produce a glossier magazine for its members, but to break the communication barrier which seems to exist between meteorologists and non-meteorologists. I went ahead and advertised a meteorology field course last summer, regardless of lack of Society sponsorship but with the help of Notre Dame University (Nelson, B.C.), and the reason it did not come to fruition was not lack of funds, but the complete lack of interest on the part of prospective students, and the lack of advice on how to find students. I was particularly disappointed that the Society's executive did not even suggest to me a possible source of such advice. Indeed, I got the impression that they regarded the whole matter as an unwelcome disruption of their normal routine.

If prospective meteorologists encounter too many such discouragements early in their careers, they will be deterred from meteorology altogether, and the C.M.S. will fail completely in its aims.

Summing up, we must have a clear-cut decision on the aims of the Society. Are they to serve the interests of the Executive, the whole membership, or the public? And should individual members do anything to further these aims, or should they just pay their subscriptions and keep quiet?

N.H. Thyer
Nelson, B.C.

To the Corresponding Secretary:

When I first wrote to you, I told you I had made a project on meteorology; today, I would like to explain the project. The group is composed of three girls and two boys; the work itself began when we went to the Richelieu Science Farm. There we worked with several instruments, made numerous readings in various locations, made our proper synopsis and found out that our predictions were true. From this initial work we built our project – the divisions were: Clouds and Wind; Instruments; and Weather Problems and Storms. We presented the project in our class and to the surprise of the group the word spread out and 13 classes wanted to see the project, and off we went ... Every class enjoyed it very much! The success of the work encouraged us to open a weather station and so we did! I did not want to stop there so I bought books, asked you for useful information and finally joined the Canadian Meteorological Society; I also made a scribbler, brought some instruments ... This is how I became so interested in meteorology and I am very glad and proud to be in the Canadian Meteorological Society. Thank you.

Denis Couture
Ottawa

NOTES FROM COUNCIL

The following were accepted as members by council:

February 23, 1971

Member	David C. Burnett	John Bantick Merrick
Student Member	Alasdair Robert Kellie Akhlesh Kumar	Thomas Warn

April 1, 1971

Member	Jacobus J. Elich William A. Murray Michael J. Newark M. Neil Parker	William H. Robertson Robert Aubrey Stachan Carl J. Thorsteinson
Student Member	Joseph G. Denis Couture	Tom B. Low

April 29, 1971

Member	Kenneth William Daly Nancy Barbara Waller	Richard Garth Wilson
Student Member	Kenneth Frederick Dewey	

June 10, 1971

Member	Matthew F. Dolan Kenneth Morice Korven Wayne R. Rouse	Christopher John Sparrow Clarence F. Spelchak W. Blake Watson
Student Member	James Bews Kerr	Venkata R. Neralla
Corporate Member	B.E. Marr, Chief Engineer, Water Investigations Branch B.C. Water Resources Service, Parliament Buildings Victoria, B.C.	

Department of the Environment

Subsequent to the establishment of the Department of the Environment on June 10, 1971, when Royal assent was given to the Government Organization Act – 1970, a press release was issued by the Canadian Meteorological Society. Excerpts from this release are given in the paragraphs quoted below.

"The Canadian Meteorological Society congratulates the Government of Canada for creating the Department of the Environment. This act is, firstly, an official acknowledgement of the fact that the natural environment affects human life so basically that it must be the subject of continuing inquiry and concern, and that there is official recognition of the need for a multi-disciplinary approach in the face of potentially serious threats to the environment and human survival.

"The new Department has been given a mandate to undertake what appears to be a well-defined and realistic program of action. We offer the wholehearted cooperation of the Canadian Meteorological Society in making it work. One of the side-benefits that may be anticipated from the program is the long overdue recognition of the new discipline of Environmental Science – of which meteorology is an important component – in overall science and education policies.

* * *

"The new Department will have many problems because it will be breaking new ground in a field where knowledge is incomplete. Intensive research must be fostered both within the Department and within universities. Furthermore, it is certain that some segments of society will suffer economic loss as a result of environmental control activities. The Canadian Meteorological Society, therefore, urges the public at large to be sympathetic as the new Department identifies its role, and takes actions which are intended to be for the greater good of all Canadians. The quality of this planet's atmosphere and water resources must be preserved at all costs."

CMS Award at the Tenth Canada-Wide Science Fair

David Jenkinson, a Grade 12 student from Holtyre, Ontario, was awarded the CMS prize for his meteorological exhibit at the Tenth Canada-Wide Science Fair held at Edmonton, May 11–15, 1971. He tackled the difficult topic *Weather Forecasting*. His display consisted of a model of a northern Ontario observing station surrounded by three panels presenting his own observations over a year or so in statistical form based on the concepts of a single-station objective forecasting system, conventional synoptic forecasting models and graphical techniques. His creativity and basic understanding were self-developed, supported by reading and his regular curricula. *Weather Ways* and the educational pamphlets of the Canadian Atmospheric Environment Service were in his "library."

The Canadian Meteorological Society was represented at the Fair by C.E. Thompson and D.B. Fraser of Edmonton who judged the exhibits. The Society's prize *The Space-Age Photographic Atlas* by Ken Fitzgerald along with a Certificate were presented to Mr. Jenkinson by C.E. Thompson. David also won a third prize of $25 in the Physical Science group. There were 85 entries and about 40 winners in a very successful National Science Fair.

REPORTS

Centre de Québec

Vendredi, le 26 février 1971, avait lieu, au Centre Audio-visuel de la Commission des Écoles Catholiques de Québec la quatrième réunion d'information de la Société de Météorologie de Québec pour la saison 1970–71. Le conférencier invité pour la circonstance fut monsieur Alcide Ouellet, chef du Bureau Météorologique de Dorval, qui a intitulé son entretien: *Faites Vos Prévisions.* Avec beaucoup d'humour, monsieur Ouellet a parlé des divers aspects des prévisions météorologiques à partir des observations, de la préparation des cartes, des prévisions proprement dites et de leurs applications dans divers secteurs de l'activité humaine : aviation, agriculture, biologie, foresterie, génie, voirie, etc.

A cette conférence, on soulignait la présence du sous-ministre adjoint des Richesses Naturelles et directeur général des Eaux, monsieur Robert-L. Ménard, qui a remis, au nom du ministre des Richesses Naturelles du Québec, monsieur J.-Gilles Massé, un octroi de son ministère à la Société de Météorologie, en témoignage d'appréciation pour l'œuvre accomplie par la Société dans la promotion des sciences météorologiques auprès du public de la région de Québec. Nous sommes très obligés aux autorités du ministère pour cette marque d'appréciation.

Un auditoire de plus de 50 personnes assistait à cette réunion, à laquelle étaient spécialement invités les membres de la Société Linnéenne de Québec.

Toronto Centre

Climate and Ecology in the Canadian North

Dr. F. Kenneth Hare combined his two loves, the weather and the forests, into an informative and entertaining evening at the Ontario Science Centre on Wednesday, April 7. His address to the Toronto Centre entitled *Climate and Ecology in the Canadian North* was billed as a free public lecture, and was attended by approximately two-hundred and fifty enthusiastic guests. The comfortable amphitheatre proved an ideal setting for the evening.

The audience was quickly transported, via colourful slides, to areas of Canada little known to most. These included the tundra, the open tundra-forest transition, and the true closed-crown boreal forest. Vivid descriptions established the separate characteristics of these three zones, each stretching across the top of Canada, from the Mackenzie to northern Labrador.

The second phase of the discussion related the observed ecosystems to the climatic characteristics of their respective regions. Thermal parameters, the mean summer position of the Arctic front, and the available and absorbed radiation entered into the analysis. It was stressed by Dr. Hare that the climate and the ecosystems were not simply cause and effect, but rather were intimately related. This is so because the differing albedo and energy absorbing properties of the ecosystems alter the atmosphere above them.

A final segment of the discussion centred around a look into the past, some five to eight thousand years. At that time the tree line was displaced to the north of its current position in the Mackenzie delta. Both fossilized tree stumps and pollen recovered from old lake bottoms have verified this fact. It was suggested that a relatively minor increase in the amplitude of the long-wave pattern could have been sufficient to produce the observed effect. In fact it is likely that such minor changes are still going on. Northern Canada is, indeed, only marginally removed from the previous ice age.

SOMAS Meeting 25 February 1971

The 22nd meeting of the NRC Subcommittee on Meteorology and Atmospheric Science was held in Ottawa on February 25, 1971.

SOMAS was pleased to note the appearance of a bill (S-11) in the Senate of Canada which provides for the obtaining of information concerning weather modification legislation. However, the committee took exception to certain sections of the bill which permitted the suppression of such information; and recommended changes in the bill to ensure *complete* disclosure of such information.

The committee received a report from Dr. André Robert to the effect that the booklet concerning Canadian GARP activities was in the hands of the printer and would be available shortly. The cost of this publication was underwritten by the National Research Council.

ANNOUNCEMENTS

Symposium – A History of Meteorological Challenges

The Atmospheric Environment Service (of Canada), previously known as the Canadian Meteorological Service, has built a new Headquarters Building in Toronto and is holding the official opening ceremonies on October 29, 1971. To further celebrate this event a Symposium, entitled 'A History of Meteorological Challenges' will be held on October 26th–28th. The concept of the Symposium is that it will review the problems which faced meteorologists over the past century, explain the stimuli to progress presented by these problems and point to the challenges of the future. This theme is appropriate since 1971 also marks the Centennial of the Canadian Meteorological Service. Attendance at the Symposium will be by invitation only.

A number of leading scientists have agreed to review the various facets of the science and practice of meteorology as detailed in the program listed below.

Speaker	*Topic*
Tuesday morning, October 26	
P.D. McTaggart-Cowan (Canada)	– The First Century of the Canadian Meteorological Service
J. Smagorinsky (United States)	– General Circulation of the Atmosphere
Tuesday afternoon, October 26	
F. Möller (Germany)	– Radiation in the Atmosphere
B.J. Mason (United Kingdom)	– Physics of Cloud and Precipitation
Wednesday morning, October 27	
R.J. Murgatroyd (United Kingdom)	– Upper Atmosphere Meteorology
B.R. Bolin (Sweden)	– Atmospheric Chemistry and Environmental Pollution
Wednesday afternoon, October 27	
R.W. Stewart (Canada)	– Atmospheric Boundary Layer
V. Suomi (United States)	– Acquisition of Meteorological Data
Thursday morning, October 28	
G.P. Cressman (United States)	– Dynamic Weather Prediction
T. Fujita (United States)	– Small-Scale Motions and Their Prediction
Thursday afternoon, October 28	
R.E. Munn (Canada)	– Applied Meteorology and Environmental Utilization
R.M. White (United States)	– Organization to Meet Challenges

These papers will be published in a hard-cover prestige publication which is expected to become an important source and reference book for several years to come. Anyone interested in the purchase of this publication can write to:

Atmospheric Environment Service,
4905 Dufferin Street,
Downsview, Ontario,
Canada.
Attn.: Symposium Committee

A number of other associated activities are planned including the 6th Session of the Joint Organizing Committee of the Global Atmospheric Research Programme. It is expected that the Symposium and the other events will constitute a memorable occasion in Canadian and international meteorology.

International Symposium on Mathematical Modelling Techniques in Water Resources Systems

Arrangements are being made to hold an International Symposium on Mathematical Modelling Techniques in Water Resources Systems in Ottawa, Ontario, Canada, May 9–12, 1972. The Symposium will bring together, probably for the first time ever, international experts from all disciplines involved with the development and application of mathematical modelling techniques to the planning, operation and management of water resources systems.

Approximately 70 per cent of the papers, including several on the state-of-the-art, will be by invitation only; the rest will be selected from unsolicited papers. The format of the Symposium is flexible enough to consider any paper on modelling that has some bearing on water resources. However, some of the suggested fields of modelling are as follows:

Economic and Social	Hydraulic
Ecologic	Hydrologic
Water Quality	Political
Estuarine	Institutional

In order to make the Symposium meaningful, the number of participants will be strictly limited. Hence, participation to the Symposium will be by invitation only.

Further details for presenting papers and/or participating in the Symposium can be obtained from:

Dr. Asit K. Biswas, Chairman
Organizing Committee
International Symposium on Mathematical Modelling Techniques in Water Resources Systems
Water and Renewable Resources Sector
Department of Fisheries and Forestry
Ottawa, Ontario, Canada.

INFORMATION FOR AUTHORS

Articles may be contributed either in the English or French language. Authors may be members or non-members of the Canadian Meteorological Society. Manuscripts for *Atmosphere* should be sent to the Editor, *Atmosphere*, P.O. Box 41, Willowdale, Ontario. After papers have been accepted for publication, authors will receive galley proofs along with reprint order forms.

Manuscripts for *Atmosphere* should be submitted in duplicate, typewritten with double-spacing and wide margins, each page numbered consecutively. Headings and sub-headings should be clearly designated and distinguished. Each article should have a concise, relevant and substantial abstract.

Tables should be prepared on separate sheets, each headed with a concise explanatory title and number.

Figures should be provided in the form of two copies of an original which should be retained by the author for later revision if required after review. A list of legends for figures should be typed separately on one or more sheets. Authors should bear in mind that figures must be reduced for reproduction, to be printed alone or with other figures. Labelling should be made in a generous size so that characters after reduction are easy to read. Line drawings should be drafted with India ink at least twice the final size on white paper or tracing cloth, and adequately identified. Photographs (halftones) should be glossy prints at least twice the final size.

Units. The International System (SI) of metric units is preferred. Units should be abbreviated only if they are accompanied by numerals, e.g., '10 m,' but 'several metres.'

Footnotes to the text should be avoided.

Literature citations should be indicated in the text by author and date. The list of references should be arranged alphabetically by author, and chronologically for each author, if necessary. Forms of abbreviation may be obtained by studying past issues of *Atmosphere*.

Italics should be indicated by a single underline.

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 and is distributed free to all members. 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.

Correspondence regarding Society affairs should be directed to the Corresponding Secretary, Canadian Meteorological Society, P.O. Box 41, Willowdale, Ontario.

There are three types of membership – Member, Student Member and Corporate Member. For 1971, the dues are $14.00, $2.00 and $40.00, respectively. Libraries and Institutions can subscribe to *Atmosphere* at the annual subscription rate of $10.00.

Correspondence relating to CMS membership or to library or institutional subscriptions should be directed to the University of Toronto Press, who have been engaged by the Society to collect membership and subscription fees, to maintain all mailing lists, as well as to print and distribute *Atmosphere*. Cheques should be made payable to the University of Toronto Press and sent to the University of Toronto Press, Journals Department, Front Campus, Toronto 181, Ontario, Canada.