Atmosphere

6th ANNUAL CONGRESS

May 31 and June 1-2, 1972

University of Alberta
Edmonton

Canadian Meteorological Society
Société Météorologique du Canada

ATMOSPHERE

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PROGRAM

SIXTH ANNUAL CONGRESS

CANADIAN METEOROLOGICAL SOCIETY

The Sixth Annual Congress and Annual Meeting of the Canadian Meteorological Society will be held at the University of Alberta, Edmonton, Alberta, May 31 and June 1-2, 1972. The theme of the Congress is "Meteorology of the North" and the technical sessions on the morning of May 31 will be devoted to invited and contributed papers on this topic. A setting for the theme will be provided by Professor W. N. Fuller, Chairman of the Department of Zoology at the University of Alberta, a scientist with wide experience in the Canadian North. Eight additional technical sessions on a variety of meteorological subjects are included in the three-day meeting. Program Chairman for the Congress is K. D. Hage.

Delegates wishing to obtain copies of individual papers are asked to list their requests with the Reprint Committee as early as possible in the course of the meeting. Copies of papers will be provided at cost during or immediately following the Congress.

The Alberta Centre of the CMS is host for the Congress. Chairman of the Local Arrangements Committee is A. F. Ingall, Atmospheric Environment Service, Edmonton.

SUMMARY OF SESSIONS

Wednesday, May 31

8:45 a.m.	Opening Welcome
9:00 a.m.	1 Meteorology of the North
1:30 p.m.	2 Mountain Meteorology
3:40 p.m.	3 Biometeorology
7:30 p.m.	Annual General Meeting of the CMS
9:00 p.m.	Wine and Cheese Party, Faculty Club

Thursday, June 1

8:45 a.m.	4 Hydrometeorology and Marine Meteorology
10:40 a.m.	5 General Meteorology
Noon	Field Trip to Alberta Hail Studies Field Station, Penhold, Alberta
1:30 p.m.	Alternate Field Trip to Micrometeorological Station, Ellerslie, Alberta, and Canadian Forestry Service Research Laboratory, Edmonton
7:00 p.m.	Banquet and Award of Patterson Medal, Royal Glenora Club

Friday, June 2

8:30 a.m.	6 Hail
10:30 a.m.	7 Weather Forecasting Research
1:30 p.m.	8 Hail and Cloud Physics
1:30 p.m.	9 Micrometeorology

SIXTH ANNUAL CONGRESS

WEDNESDAY MORNING MAY 31, 1972 — 8:45 a.m. - noon

Opening Welcome: Dr. M. Wyman, President
University of Alberta (or his representative)
C.M. Penner, President
Canadian Meteorological Society

SESSION 1 — Meteorology of the North

Chairman: H.P. Wilson

A BIOLOGIST LOOKS AT THE NORTH — 35 min.
Prof. W.N. Fuller, University of Alberta

THE RADIATION CLIMATE OF MEIGHEN ISLAND ICE CAP, NWT — 20 min.
Bea Barge, McGill University

ACCUMULATION STUDIES IN NORTHERN ELLESMERE ISLAND — 15 min.
K.E. West, University of Calgary
G. Hattersley-Smith, DRB, Ottawa and
H.R. Krouse, University of Calgary

Coffee (10:25 - 10:55)

THE POLAR INVERSION: A REVIEW AND SOME RECENT STUDIES IN NORTHWEST NORTH AMERICA — 30 min.
Aylmer H. Thompson, Texas A & M University and
University of Alaska

A NOTE ON RELATIVE HUMIDITY AT LOW TEMPERATURES — 15 min.
Richmond W. Longley, University of Alberta

SHORT CONTRIBUTION:

AN ANALYSIS OF THE OCCURRENCE OF POLAR DESERT AREAS — 5 min.
M.J. Bovis, Institute of Arctic and Alpine Research,
Boulder, Colorado

WEDNESDAY AFTERNOON MAY 31, 1972 1:30 p.m. - 5:00 p.m.

SESSION 2 Mountain Meteorology

Chairman: E. R. Reinelt

AN EXPERIMENTAL AND THEORETICAL STUDY OF LEE WAVES FROM A COMPLEX MOUNTAIN CHAIN — 20 min.
Neil Cherry, McGill University

A LEE-WAVE EXPLANATION FOR WEATHER ANOMALIES IN ALBERTA — 20 min.
H. P. Wilson, Atmospheric Environment Service, Edmonton

ON CYCLOGENESIS IN THE LEE OF THE CANADIAN ROCKY MOUNTAINS — 20 min.
Y. Chung and E. R. Reinelt, University of Alberta

A NUMERICAL STUDY OF THE INFLUENCE OF OROGRAPHY ON SYNOPTIC-SCALE ATMOSPHERIC MOTION — 20 min.
M. L. Khandekar, University of Alberta

Coffee (3:10 - 3:40)

SESSION 3 Biometeorology

Chairman: G. W. Robertson

MODEL EXPERIMENTS ON FREE CONVECTION HEAT AND MASS TRANSFER OF LEAVES AND PLANT ELEMENTS — 20 min.
P. H. Schuepp, McGill University

LEAF TEMPERATURES AS AFFECTED BY CONTROLLED ENVIRONMENTAL FACTORS — 20 min.
N. Barthakur and A. Kumar, McGill University

SURFACE DIFFUSIVE RESISTANCE TO VAPOUR FLOW FOR A DOUGLAS FIR FOREST — 20 min.
K. G. McNaughton and T. A. Black, University of British Columbia

THURSDAY MORNING JUNE 1, 1972 8:45 a.m. - noon

SESSION 4 Hydrometeorology and Marine Meteorology

Chairman: D. Storr

SNOW ACCUMULATION AS INFLUENCED BY TOPOGRAPHY, AND ITS CORRELATION WITH ANNUAL AND SEASONAL STREAMFLOW ON MARMOT BASIN — 20 min.
Douglas L. Golding, Canadian Forestry Service, Edmonton

SALT AND WETTING PERIMETER COMPLICATIONS TO STANDARD EVAPORATION CALCULATIONS — 20 min.
Jeffrey M. Whiting, Saskatchewan Research Council

PRELIMINARY COMPUTATIONS OF THE HORIZONTAL TRAJECTORIES OF OIL SLICKS OVER OCEANS — 20 min.
M.L. Khandekar, University of Alberta and
T.S. Murty, Marine Sciences Branch, DOE, Ottawa

METEOROLOGICAL ASPECTS OF FROZEN SEA RESEARCH — 10 min.
E.R. Walker, Frozen Sea Research Group, Victoria

Coffee (10:10 - 10:40)

SESSION 5 General Meteorology

Chairman: D. Storr

A METEOROLOGICAL CALIBRATION OF A BACKSCATTER VISIBILITY METER (VIDEOGRAPH) — 20 min.
W.L. Clink and Brian E. Sheppard, Atmospheric Environment Service, Toronto

VERIFICATION OF TERMINAL FORECASTS USING THE RANKED PROBABILITY SCORE — 20 min.
John D. Reid, Atmospheric Environment Service, Winnipeg

AN ANALYSIS OF COH VALUES IN EDMONTON — 20 min.
Richmond W. Longley, University of Alberta

SHORT CONTRIBUTIONS:

Titles to be announced

FRIDAY MORNING JUNE 2, 1972 — 8:30 a.m. - noon

SESSION 6 — Hail

Chairman: P. W. Summers

HAIL RESEARCH AROUND THE WORLD (Invited paper) — 25 min.
Walter Hitschfeld, McGill University

ON THE INTERPRETATION OF HAILSTONE STRUCTURES — 20 min.
R. List and T. A. Agnew, University of Toronto

THE ECONOMIC IMPACT AND REGIONAL VARIATION OF HAIL DAMAGE IN ALBERTA — 20 min.
Lubomir Wojtiw and Peter W. Summers, Research Council of Alberta

Coffee (9:55 - 10:25)

PROGRESS TOWARDS DEVELOPING A RADAR POLARIZATION FACILITY FOR DETECTING HAIL IN ALBERTA — 20 min.
B. L. Barge, Research Council of Alberta

THE INTERACTION OF ALBERTA HAILSTORMS WITH ENVIRONMENTAL AIR — 20 min.
Neil Cherry and R. R. Rogers, McGill University

THE KINEMATICS OF MULTICELL AND SUPERCELL ALBERTA HAILSTORMS — 20 min.
A. J. Chisholm, Atmospheric Environment Service, Toronto, and
J. H. Renick, Research Council of Alberta

THE GROWTH OF LARGE HAIL: STUDIES DERIVED FROM ALBERTA AND MONTREAL HAILSTORMS — 20 min.
Marianne English and Walter Hitschfeld, McGill University

FRIDAY MORNING JUNE 2, 1972 — 10:30 a.m. - noon

SESSION 7 — Weather Forecasting Research

Chairman: F. B. Muller

THE COMPUTERIZED USE OF HOURLY WEATHER DATA — 20 min.
A. L. Bealby, Atmospheric Environment Service, Toronto

ON THE PROPAGATION OF LOCAL ERRORS IN A PRIMITIVE EQUATIONS MODEL — 20 min.
J. F. Derome, Atmospheric Environment Service, Montreal

WEATHER DEPICTION USING REGRESSION TECHNIQUES — 20 min.
E.C. Jarvis, Atmospheric Environment Service, Toronto

THE UNIVERSITY OF ALBERTA METEOROLOGICAL SATELLITE RECEIVING STATION — 10 min.
P. Hof, University of Alberta

FRIDAY AFTERNOON JUNE 2, 1972 — 1:30 p.m. - 5:00 p.m.

SESSION 8 — Hail and Cloud Physics

Chairman: P.W. Summers

THE SEEDABILITY OF SUPER AND MULTICELL HAILSTORMS USING DROPPABLE PYROTECHNIC FLARES — 20 min.
J.H. Renick and P.W. Summers, Research Council of Alberta
A.J. Chisholm, Atmospheric Environment Service, Toronto

PROJECT HAILSTOP - A REVIEW OF ACCOMPLISHMENTS TO DATE — 20 min.
Peter W. Summers, Research Council of Alberta

AN AERODYNAMIC MODEL FOR THE TUMBLING OF SPHEROIDAL HAILSTONES ABOUT A HORIZONTAL MAJOR AXIS — 20 min.
E.P. Lozowski, University of Alberta, and
R. List, University of Toronto

HAIL RESEARCH - A BRIEF SYNTHESIS OF RESULTS PRESENTED AT THE SIXTH ANNUAL CONGRESS — 20 min.
R. List

Coffee (3:05 - 3:35)

A HARMONIC ANALYSIS OF ATMOSPHERIC ELECTRICITY PARAMETERS — 20 min.
Bhartendu, Atmospheric Environment Service, Toronto

THE ELECTRIFICATION OF A TNT EXPLOSION CLOUD — 20 min.
D.R. Lane-Smith, University of Western Ontario

A LINEAR ACCELERATOR FOR WATER DROPS — 20 min.
J.D. McTaggart-Cowan and R. List, University of Toronto

FRIDAY AFTERNOON JUNE 2, 1972 1:30 p.m. - 4:45 p.m.

SESSION 9 Micrometeorology

Chairman: O. Johnson

SOLAR RADIATION ABSORPTION IN ICE AND WATER 15 min.
R. Gilpin, University of Alberta

CALIBRATION AND TESTS OF A YAW SPHERE-THERMOMETER SYSTEM FOR SENSIBLE HEAT FLUX MEASUREMENTS 20 min.
D. Yap, T.A. Black, T.R. Oke, and R. Wilson,
University of British Columbia

DATA ACQUISITION SYSTEM FOR EDDY FLUX MEASUREMENTS 20 min.
J.L. Honsaker, F. McDougall, and
D. Oracheski, University of Alberta

THE RELATIONSHIP OF THE POSITION OF ATMOSPHERIC THERMAL STRUCTURES TO THE POSITION OF HEAT SOURCES ON THE SURFACE 20 min.
R.M. Holmes, Environment Resource Airborne
Instruments Ltd., Calgary

Coffee (3:05 - 3:35)

MICRO-SCALE PRESSURE SIGNATURES FROM STORMY WEATHER SYSTEMS 20 min.
M.J. Curry and R.C. Murty, University of
Western Ontario

FILM : THE BALLAD OF THE ICE-WORM COCKTAIL 30 min.
Prepared and presented by Prof. R. Gilpin,
Department of Mechanical Engineering,
University of Alberta

ABSTRACTS

SESSION 1: Meteorology of the North

A BIOLOGIST LOOKS AT THE NORTH
W.N. Fuller

Abstract not available.

THE RADIATION CLIMATE OF MEIGHEN ISLAND ICE CAP, NWT
Bea Barge

Meighen Island, located on the edge of the Polar Ocean at 80° N, bears a small ice cap which rises only 267 m above msl. Measurements of incoming and outgoing short- and all-wave radiation, made during the field seasons of 1968-70, form the basis for a discussion of the radiation climate of the ice cap. The effects of cloud surface and weather conditions on the radiation components are examined. Particular attention is given to the influence of the extremely frequent fog conditions on the surface radiation balance. Results suggest the existence of several types of fog depending on the synoptic situation. The radiation characteristics of these synoptic types are related to the mass balance of the ice cap providing insight into the reasons for the existence of Meighen Ice Cap.

ACCUMULATION STUDIES IN NORTHERN ELLESMERE ISLAND
K.E. West, G. Hattersley-Smith and H.R. Krouse

Abstract on page 22.

THE POLAR INVERSION: A REVIEW AND SOME RECENT STUDIES IN NORTH-WEST NORTH AMERICA
Aylmer H. Thompson

The dynamic and radiation processes of inversion formation and maintenance are outlined and the several kinds of inversions are described. Climatological data show that (except for the tropopause) the most intensive, extensive and persistent are the trade inversion and the polar inversion, with the former being more extensive, but the latter stronger. H. Wexler's classic investigation attributes the formation of polar continental air from polar maritime air to radiation processes, during which the strong surface or low-level polar inversion is formed. This continues to be accepted as the major cause of the polar inversion.

Several studies of the climatology of the polar inversion for single stations and for large areas reveal wide variations in frequency, thickness of the inversion layer, and intensity of ground-based and low-level polar inversions. These studies often emphasize the many modification factors which act. A summary of such results is presented.

Synoptic studies are less common, but have been performed on some data. Examples, primarily from Antarctic regions, are described.

Recent investigations for Alaskan interior locations reveal the extreme rapidity of inversion formation once the development processes are established. Present efforts include evaluating the relative magnitudes of the various processe

leading to development, maintenance and dissipation. Results emphasize the significance of radiative exchanges as the prime development and dissipation mechanisms, in accord with Wexler's conclusions, and also demonstrate quantitatively the extreme sensitivity of the actual inversion structure and its changes to low and middle tropospheric changes in moisture content, temperature and cloud structure. Advection, changes in moisture, cloud development, etc., all seem to be more effective in changing the radiation balance than in modifying the inversion directly. Seemingly small changes in such parameters may result in rather large changes in the structure of the polar inversion within a few hours.

A NOTE ON RELATIVE HUMIDITY AT LOW TEMPERATURES
Richmond W. Longley

A study of the relative humidities recorded in winter in the Arctic regions of Canada has shown that, on the average, relative humidity drops with temperature. This is true both of surface humidities reported in radiosonde reports but taken in the usual manner in thermograph screens and at 950 mb and taken by radiosondes. An analysis of the physical processes in the Arctic deduced that the reverse should be true and that cold temperatures should have high relative humidities. This comparison leads one to suspect that the observation of relative humidity at subzero temperatures leads to questionable results.

AN ANALYSIS OF THE OCCURRENCE OF POLAR DESERT AREAS
M.J. Bovis

Abstract not available.

SESSION 2: Mountain Meteorology

AN EXPERIMENTAL AND THEORETICAL STUDY OF LEE WAVES FROM A COMPLEX MOUNTAIN CHAIN
Neil Cherry

The results of a study of lee waves produced by a complex mountain chain, the Southern Alps, Canterbury, New Zealand, are presented. Observations were made using super-pressure balloons and satellite photographs and additional data were derived from the anomalous ascent rates of radiosondes. A comparison is made between these results and the solutions of the lee-wave equation in simple one-, two- and three-layer models to assess their applicability in a complex situation.

A LEE-WAVE EXPLANATION FOR WEATHER ANOMALIES IN ALBERTA
H. P. Wilson

Among meteorologists having experience with Alberta weather, it is well known that there are three main local peculiarities. Chinooks are frequent in winter, the incidence of hail is abnormal in summer, and the frequency of cyclogenesis is relatively high throughout the year. An attempt is made to explain these anomalies on the basis of lee-wave theory.

ON CYCLOGENESIS IN THE LEE OF THE CANADIAN ROCKY MOUNTAINS

Y. Chung and E.R. Reinelt

Cyclogenesis on the lee slope of the Canadian Rocky Mountains was examined in the light of present theories of cyclone initiation and development. Cyclogenesis may be caused by vorticity advection in the middle and upper troposphere, but the basic mechanism responsible for the initiation of most lee cyclones, particularly of feebl and non-developing systems, seems to be upper-air divergence. In the course of the present study it was observed that most lee cyclones formed initially under the eastern margin of a 500-mb, orographically intensified, diffluent cross-barrier flow, superimposed on a zone of low level convergence and orographic descent. However, sudden intensification of a mobile cyclone usually commences with the onset of positive vorticity advection, in accordance with Petterssen's hypothesis.

Analysis of a sample of 146 cyclones indicates that the frequency maximum of lee cyclogenesis in the Canadian Rockies is not a single centre, but comprises three distinct maxima. The main centre of activity is located in the lee of the southwest Alberta Range, while secondary maxima occur in the lee of the northern B.C. Range and the Mackenzie Mountains. The frequency maxima appear about 200-250 km from the Continental Divide, in a region of vertical stretching and subsidence.

A NUMERICAL STUDY OF THE INFLUENCE OF OROGRAPHY ON SYNOPTIC-SCALE ATMOSPHERIC MOTION

M. L. Khandekar

In an attempt to understand the dynamical influence of orography on synoptic-scale motion of the atmosphere, a two-layer numerical model is formulated. The model assumes an atmosphere consisting of two superimposed layers of incompressible, homogeneous, inviscid fluid with a free surface. Within each layer the horizontal velocities and pressure forces are independent of height. For each layer, a set of primitive equations is formulated. These equations are integrated over a rectangular channel bounded on the north and south by two parallel "walls" extending in the east-west direction. A periodicity condition is applied at the east and west boundaries. A rectangular mountain of parabolic shape is placed at the bottom of the lower layer. The steady-state solutions in the absence of mountains are used as initial conditions.

For numerical integration a two-step Lax-Wendroff integration scheme is employed. Using a horizontal grid size of 250 km the model equations are integrated for a period of 2 to 5 days. Initially the model is integrated for a uniform westerly flow with no vertical shear; the shape and size of the mountain are prescribed by a simple mathematical function. Later, more realistic mountain forms will be considered so as to resemble the western mountain-complex of North America. Also, more realistic initial conditions for the westerly flow will be considered both with and without a vertical shear.

Preliminary results indicate that the model can simulate some observed features of the orographic effects on atmospheric flow patterns. The implications of these results for development of a prediction model for western Canada will be considered.

MODEL EXPERIMENTS ON FREE CONVECTION HEAT AND MASS TRANSFER OF LEAVES AND PLANT ELEMENTS

P. H. Schuepp

The free convection ionic mass transfer to flat plates of different shapes and dimensions, metal coated leaves, groups of leaves and other elements of vegetation has been studied.

An analysis is presented of the effects of inclination, shape factors, and of spatial restrictions to convective flow, both laminar and turbulent. The validity of commonly used analytical expressions for the Nusselt and Sherwood numbers, which are based on flat plates and cylinders, is tested and an attempt is made to interpret the discrepancies found by other researchers between predicted and measured free convection heat transfer coefficients of plants in air.

LEAF TEMPERATURES AS AFFECTED BY CONTROLLED ENVIRONMENTAL FACTORS

N. Barthakur and A. Kumar

A wind tunnel and an external microwave energy source formed the basis of a new and improved experimental technique to investigate many complex functional relationships between climatic parameters and leaf characteristics. Leaf temperatures (as a function of wind speed) of a variety of live, dry, and intact leaves of non-hardy plants were studied for various air temperatures at constant relative humidity and absorbed incident radiation. Similar studies were also carried out on wet foliage surfaces. A few experimentally determined plant-environment interactions are compared with the predicted curves obtained by solving the energy balance equation for a single leaf.

Convective heat transfer coefficients of attached leaves, under both free and forced airflow conditions, were determined on the basis of steady- and unsteady-state methods. Dependence of convection coefficients on excess temperature, wind velocity, leaf size and shape, and surface roughness, are explored. Analytical heat transport formulas, which are valid for flat plates, underestimate the free convection coefficients of attached leaves, particularly for those leaves which possess considerable surface roughness elements.

SURFACE DIFFUSIVE RESISTANCE TO VAPOUR FLOW FOR A DOUGLAS FIR FOREST

K. G. McNaughton and T. A. Black

Surface diffusive resistance to vapour flow for a Douglas fir forest has been calculated from micrometeorological data for a 17-day dry period using Monteith's combination formula derived for a single extensive flat leaf canopy model. For days early in the period, surface resistance was about 75 sec/m. For later days the values increased substantially especially when there was a high atmospheric demand for water.

If the surface diffusive resistance is identified with the stomatal diffusive resistance of the needles acting in parallel, then it appears that stomatal closure begins at soil water tensions in the root zone as low as 0.1 bar when the transpiration rate is high. This again emphasizes the importance of including plant physiological parameters for accurate calculation of transpiration from vegetated surfaces.

Several definitions of the concept of potential evaporation are examined and their relevance to forest evapotranspiration discussed.

SESSION 4: Hydrometeorology and Marine Meteorology

SNOW ACCUMULATION AS INFLUENCED BY TOPOGRAPHY, AND ITS CORRELATION WITH ANNUAL AND SEASONAL STREAMFLOW ON MARMOT BASIN

Douglas L. Golding

In a regression model relating snow accumulation to 16 topographic and stand variables on Marmot Creek experimental watershed, 36 per cent of the variance was accounted for. Addition of variables indexing the primary and secondary location of snow-measurement points relative to major topographic features of the basin improved the model only slightly, although of the four most significant variables, two were combinations of primary and secondary position.

To determine how well snow courses that have been measured for the past 10 years indexed actual snow accumulation on the basin, snow course data were correlated with mean snow-water equivalent measured in 1969, 1970, and 1971 at 1200 points on a 1 x 10-chain grid across the basin. Correlation coefficients ranged from 0.95 to 0.99 with particular snow courses consistently having the highest values, indicating that these courses provide a good index of basin snow accumulation.

Annual and seasonal streamflow from Marmot basin and three sub-basins were correlated with both snow course and the 1 x 10-chain grid data. In both cases, highest correlations were obtained for May-June runoff (correlation coefficients of 0.76 to 0.99), followed by May-July runoff, and lastly annual flow. Higher correlations were obtained for the relation of runoff with snow course data than with grid data.

SALT AND WETTING PERIMETER COMPLICATIONS TO STANDARD EVAPORATION CALCULATIONS

Jeffrey M. Whiting

An automatic hydrological recording station was designed and installed on a platform in Big Quill Lake. Big Quill Lake (IHD) project is a representative basin study of a highly saline (5%), shallow (3 m) saucer shaped lake covering 100 mi^2 in central Saskatchewan. The battery powered magnetic tape recorder and sensors were bought commercially and were chosen so that in general the sensors could be used without interfacing. However, in the late stages of development, it was decided to include a 5-probe temperature profile which for accuracy of comparison (0.1° C) required a stabilizer interface. The temperature profile was mounted upon a low buoyancy float.

The station was designed to answer problems found in the accuracy of evaporation calculations and in the measurement of lake level. Theoretical calculations of evaporation consistently showed more water loss than actually occurred. The major errors were in:

1) salt-water temperature calculations from air temperature;
2) wind (slosh) wetting of shore areas (200,000 ft^2 change at 15 mph);
3) increases in water density decreased surface vapour pressure.

Lake-level measurements (accuracy $\pm$ 0.001 ft/2 min) from a digital nitrogen bubbler system showed a diurnal cycle during unusual calm periods. Spectral anal

ysis confirmed that, in the average 15-day period, the power density peaked at 1.3 cycles/day. The hydrometeorological station therefore included sensors for the wind vector and water density.

Computer programs were devised to handle data banking and access for comparisons, statistical packages and graphing through a Calcomp plotter.

PRELIMINARY COMPUTATIONS OF THE HORIZONTAL TRAJECTORIES OF OIL SLICKS OVER OCEANS

M. L. Khandekar and T. S. Murty

The formation of oil slicks over oceans and large water bodies has assumed considerable importance in recent years because of its impact on the environment and coastal areas. A knowledge of the movement and spread of oil slicks over oceans would be very useful from an operational point of view. In this study, a numerical approach is made to investigate the horizontal movement of oil slicks. An analysis of the observed data on oil slicks during the "Torrey Canyon" episode of March-April 1967 in the North Sea and that in the Gulf of St. Lawrence in September 1970 indicated rather large values (of the order of 10^{-4} sec^{-1}) for the vorticity of individual oil slicks. Thus the individual oil slicks may be visualized as a set of rectilinear vortices whose movements can be calculated by considering their mutual interaction; the movement of the oil slicks will also be influenced by the steering current in which they may be embedded.

Using the hydrodynamical theory for a set of rectilinear vortices, a system of ordinary differential equations is formulated which governs the movement of individual oil slicks due to their mutual interaction with each other. The theory also enables us to consider the influence of a steering current which may be visualized in the form of prevailing winds, tidal currents or wind-driven oceanic circulations.

A numerical integration procedure is used to calculate the trajectories of individual oil slicks both with and without a steering current. Preliminary computations indicate that the trajectory of an individual oil slick is considerably influenced as a result of its interactions with other oil slicks. It is suggested that the influence of mutual interactions should be taken into account, at least under some conditions, in predicting the movement of oil slicks.

METEOROLOGICAL ASPECTS OF FROZEN SEA RESEARCH

E. R. Walker

Abstract not available.

SESSION 5: General Meteorology

A METEOROLOGICAL CALIBRATION OF A BACKSCATTER VISIBILITY METER (VIDEOGRAPH)

William L. Clink and Brian E. Sheppard

A multi-parameter calibration of the Videograph backscatter visibility meter against routine airways observations was obtained from a one-year set of data gathered at Toronto International Airport.

The Videograph is a single-ended backscatter meter. A Xenon flash lamp projector and a photodiode detector are housed together and the optical fields-of-view are arranged to measure the backscatter power of a small region of the atmosphere extending horizontally from about 3 to 30 m from the instrument. The

instrument tested contained an automatic monitor arrangement to detect changes in its internal calibration.

The comparison was with the routine estimate of prevailing visibility supplied as part of the airways observation by qualified meteorological observers. For analysis purposes, it was assumed that standard observing practices were followed in the specification of visibility classes and that we could allocate the observation to the geometrical mid-point of the class whose lower limit was defined by the observation.

The data were arranged into nearly simultaneous pairs and, for the purpose of this analysis, the data were severely edited to 2200 pairs to restrict attention to reasonably uniform or slowly varying conditions. All analysis was by hand and eyeball. The initial analysis considered the following as independent parameters: Winter/Summer, Night/Day/Twilight, Blowing Snow, Snow, Haze and Smoke, Fog, Drizzle, Rain and Unspecified obstruction. Where more than one obstruction to vision was reported, the above list constituted a hierarchy, that is, combined rain and fog was initially allocated to the fog analysis.

After the initial analysis, we were satisfied to eliminate the Winter/Summer and the Blowing Snow/Snow discriminations. The Twilight data fell generally and reasonably uniformly between the Night and Day analyses and, for this reason and the lesser significance of the smaller data fields, were discarded. A detailed comparison of the combination Rain and Fog data with the individual Rain and Fog analsis led us to reconsider our hierarchy and to transfer most of these data to the Rai analysis. It appears here that rain is the dominant obscurant at low visibilities in most combined Rain/Fog observations.

The final analyses suggest that:

1. A common calibration for the many obscurants might be acceptable for visibilit ranges beyond one mile.
2. At visibilities below one mile, there is a widening variation among obstruction parameters which would likely require separate consideration of Snow, Fog and Rain. Snow has the greatest scattering power for a given visibility, Rain the least.
3. For given parameters and backscattering power, visibility is about 50% greate at night than by day.
4. Simple inverse relationships of the form:

   $\text{Visibility} \times (\text{Backscatter})^{K} = \text{Constant}$

appear to be applicable to Rain as an obstruction parameter, but not to Fog or Snow

VERIFICATION OF TERMINAL FORECASTS USING THE RANKED PROBABILITY SCORE

John D. Reid

A terminal forecast verification scheme assessing forecast operational utility has been developed employing the Ranked Probability Score RPS. The forecast is interpreted in terms of expected probabilities of six operationally significant ceiling and visibility classes. Probability interpretations of the terms VRBL, OCNL, RSK etc., are used. The differences between the RPS of the forecast and those of climatology and persistence are used as crude indices of forecast skill.

Monthly mean figures have been compiled indicating the decay of forecast accuracy with time into the forecast period. Comparisons with climatological and persistence "forecasts" are presented.

AN ANALYSIS OF COH VALUES IN EDMONTON

Richmond W. Longley

A careful analysis was made of the COH values obtained from six observing sites in Edmonton during the 5-year period 1966-1970. Weekly and annual trends were suppressed by grouping by 3-month periods (seasons) and by separating off Saturday and Sunday values from the weekday values.

The analysis has shown that the station values differ considerably. Correlations from station to station are low. The wind rose for those times when COH were high differ from station to station. Also, when the COH at one station is high with a strong wind, greater than 10 mi hr^{-1}, the observed COH at the other stations are frequently low and are at times zero. Yet periods of high winds are periods when the distribution of pollutants within the atmosphere should approach uniformity.

The conclusion from the study is that the sampling of COH produces values that are representative of the location of the instrument, but not of the city as a whole. This suggests that the sampling of other pollutants, such as carbon monoxide, at one point only is giving very little information of the city-wide values.

SESSION 6: Hail

HAIL RESEARCH AROUND THE WORLD

Walter Hitschfeld

A brief review is attempted of activities in hail research — field and laboratory observations, and theoretical studies — in the U.S. (Colorado, South Dakota, Illinois), U.S.S.R., Italy, France and South Africa.

ON THE INTERPRETATION OF HAILSTONE STRUCTURES

R. List and T. A. Agnew

Preliminary experiments on the growth of artificial hailstones in a vertical icing tunnel have shown that the mean planar air bubble diameter and the mean surface of single crystals in an ice deposit depend on both the air temperature and the liquid water content. Together with bubble concentrations and new concepts on hailstone aerodynamics, new avenues for the interpretation of hailstone history seem to open up.

THE ECONOMIC IMPACT AND REGIONAL VARIATION OF HAIL DAMAGE IN ALBERTA

Lubomir Wojtiw and Peter W. Summers

During the period 1939 to 1971 the average loss to risk ratio for the whole province averaged about 5.0%. This figure varied widely from year to year, ranging from a high of 9.4% in 1945 and 1947 to a low of 2.0% in 1955 and 1964. Using the total annual value of grain crops produced in Alberta for several years, together with corresponding loss figures, the annual direct loss to crops is estimated to average between $20 and $25 million. Additional damage to property, whilst more variable from year to year, averages several million dollars annually. Including a multiplier factor of 1.5, because of reduced business activity in farming communities affected by hail, gives a total real loss to the Alberta economy due to hail damage between $30 and $40 million annually.

The hail losses are far from evenly spread throughout the province. The long-term 34-year average distribution of hail damage shows several belts of heavy damage which in turn suggests a few preferred "generation areas" or "breeding grounds" for hailstorms in the foothills. In any one year the hail damage is typically confined to a few regions. On this regional scale the economic effects can be very severe, since in several years losses in areas of the order of 1000 mi^2 can be as high as 30%. The storm of 23 July 1971 was an extreme example of this, when 93% of the insured crops were destroyed in an area of 625 mi^2 near Red Deer.

PROGRESS TOWARDS DEVELOPING A RADAR POLARIZATION FACILITY FOR DETECTING HAIL IN ALBERTA

B. L. Barge

Data obtained with the original Alberta Hail Studies 3.2-cm radar, equipped with an antenna to provide good vertical resolution, have indicated that maximum echo heights are related to the probability of hail occurrence. More recently, the development of a high resolution 10-cm radar has provided radar reflectivity data which have been used with partial success in distinguishing surface rain reports from hail reports. Combinations of the reflectivity and maximum echo height have also been suggested as a hail indicator.

A new method which shows promise in assigning a radar "signature" to hail utilizes the polarization equipment of the present radar. Low elevation radar measurements of the depolarization (which arises from the deformed nature of precipitation particles) and reflectivity have been compared to surface precipitation reports. For reflectivities in the important region between 30 and 50 dBZ it has been found that a combination of the amount of depolarization together with the reflectivity was most effective in distinguishing hail.

THE INTERACTION OF ALBERTA HAILSTORMS WITH ENVIRONMENTAL AIR

Neil Cherry and R. R. Rogers

Serial radiosonde ascents from Penhold, Alberta, were analyzed to find the variations in height and time of temperature, potential temperature (dry and wet bulb), moisture, convective stability and wind velocity. This information is compared with previous analyses of the same hailstorms based on pibals and radar observations. An indication is given of the representativeness of radiosondes in describing the storm environment, as a function of their distance in space or time from the storm.

A comparison is made of convective stability, storm activity and the vertical velocity of a buoyant parcel computed from parcel theory.

THE KINEMATICS OF MULTICELL AND SUPERCELL ALBERTA HAILSTORMS

A. J. Chisholm and J. H. Renick

The Alberta Hail Studies Project has observed a broad spectrum of hailstorms over the past five years with a 1.15° beam 10-cm radar. These observations are reviewed with respect to the influence of the ambient wind and storm energy on the development and persistence of the two characteristic storm types, namely, the organized multicell and supercell storms, for which descriptive models of the reflectivity structure, airflow and hailfall are presented.

Supercells, characterized by a bounded weak echo region that is coincident with a broad strong updraft, are organized by the wind pattern with a slight side

tilt such that parallel but separate updraft and fallout zones develop resulting in a stable, persistent storm airflow.

By contrast, multicell storms may or may not be organized depending upon the wind pattern and intensity. Cells in these storms develop in a vertical stance such that the precipitation loads the updraft causing it to decay rapidly. The organized multicell storm propagates by means of a recurring pattern of cell development on its right hand flank, with each cell exhibiting a time dependent behaviour and a short lived weak echo region.

THE GROWTH OF LARGE HAIL: STUDIES DERIVED FROM ALBERTA AND MONTREAL HAILSTORMS

Marianne English and Walter Hitschfeld

The growth of hail in four storms is modelled. Three of the storms occurred in Alberta, one over Montreal Island. Hailstones up to 7.5 cm across and with masses up to 70 g were collected from these storms. Measurements of axial ratios of the stones indicate that the larger ones are never spherical, but have an average axial ratio of about 0.7.

Using analyses (by others) of radar, stereo-cloud photography and aircraft-measured cloud base updraft data for these four storms, a two-dimensional cloud model characterized by a sloping updraft is derived. Assuming the existence of a few millimetre-size embryos in the low levels of the updraft, theoretical modelling of the hail growth has shown that an oblate hailstone can grow to 70 g, in a simple up and down trajectory, in 25 min.

SESSION 7: Weather Forecasting Research

THE COMPUTERIZED USE OF HOURLY WEATHER DATA

A. L. Bealby

The computerized use of hourly weather data in main weather offices will be discussed. Reference will be made to experience in setting up a complete system for computer reception and processing of hourly weather data. Presently the system produces listings of hourly reports, plots of basic weather elements, contoured objective analysis of mean sea level pressure and associated derived parameters, and contoured short-range predictions of mean sea level pressure and associated derived parameters.

ON THE PROPAGATION OF LOCAL ERRORS IN A PRIMITIVE EQUATIONS MODEL

J. F. Derome

Numerical experiments have been performed to determine the way in which initial errors of relatively small horizontal extent propagate in a barotropic primitive equations model. Six-day forecasts are made with the model, starting from initial conditions which are assumed to be free from errors. The forecasts are then repeated using the same initial data, except for a small area near the Gulf of Alaska where an error in the form of a low pressure system is added. The difference between the two forecasts, or error, is then examined as a function of time. The results obtained from sixteen cases run with winter data indicate that on the average the largest value in the error travels, in six days, from the Gulf of Alaska to the western tip of the Great Lakes and decreases in amplitude by a factor slightly

greater than 2 for an initial amplitude of 8.4 dam at 500 mb. The area over which the error is 1 dam or more, on the other hand, grows by a factor of about 13 in the first six days of the forecasts, resulting in a net increase of nearly 50 percent in the root mean square error computed over the entire forecast area.

WEATHER DEPICTION USING REGRESSION TECHNIQUES
E.C. Jarvis

Sixteen potential predictors composed of geophysical quantities and kinematic and thermodynamic fields obtained from aviation weather reports were screened to obtain regression estimates of weather in 3 categories: (i) ceilings $< 1,000$ ft and/or visibilities < 3 mi; (ii) ceilings 1,000 to 3,000 ft and visibilities ≥ 3 mi; (iii) ceilings $> 3,000$ ft, or ceilings unlimited, and visibilities ≥ 3 mi. Area representations of the large-scale structure of ceilings and visibilities in the 3 categories appear to be operationally useful in data-sparse areas and in regions where geophysical factors are difficult to evaluate subjectively. The procedure can be applied every hour, if desired, and is applicable to forecasts of weather depictions using the "perfect prog" approach.

THE UNIVERSITY OF ALBERTA METEOROLOGICAL SATELLITE RECEIVING STATION
P. Hof

A description of the Satellite Receiving Station operated by the Institute of Earth and Planetary Physics, University of Alberta, with emphasis on ELSA, the Electronic Lobe Switching Antenna. This antenna system, designed and built by Vaisala, eliminates most tracking problems and orbital calculations.

SESSION 8: Hail and Cloud Physics

THE SEEDABILITY OF SUPER AND MULTICELL HAILSTORMS USING DROPPABLE PYROTECHNIC FLARES
J.H. Renick, P.W. Summers and A.J. Chisholm

A supercell and several multicell hailstorms were seeded with silver iodide during Project Hailstop 1970 and 1971. The seeding was accomplished by a T-33 aircraft releasing droppable pyrotechnic flares while overflying newly developing cells on the southern or southwestern side of the storm. The experiments have been designed for physical rather than statistical evaluation using quantitative 10-cm radar data, dense surface hail surveys and analysis of rain and hail samples for silver content. These latter data have revealed silver in specific pockets of precipitation within the hailswath. Since the location of the seeding was well defined in space and time, an explanation for the silver fallout patterns is advanced on the basis of the air flows within multicell and supercell hailstorms. The ramifications of these concepts are discussed with respect to the seedability of differing storm types.

PROJECT HAILSTOP - A REVIEW OF ACCOMPLISHMENTS TO DATE
Peter W. Summers

Since 1956 the Alberta Hail Studies Project has been collecting and analyzing data on most aspects of Alberta hailstorms. Substantial progress has been made in developing descriptive models of hailstorm kinematics and numerical models of

hailstone growth. Although still far from complete this understanding of hailstorms reached the point where worthwhile cloud seeding experiments could begin and run in parallel with continued "basic" research. As a result "Project Hailstop" was conceived in 1969 and implemented in 1970.

A seeding concept applicable to at least one type of damaging hailstorm frequently observed in Alberta was proposed. A droppable pyrotechnic flare system was developed early in 1970 and given a limited trial in July 1970. On the basis of this test some improvements were made in the system which was then given a fuller trial in the 1971 hail season. A total of 16 experiments were carried out during the two summers on several hailstorm types.

The experiments to date are discussed in terms of: (i) the logistics and practicality of the seeding system; (ii) the success in observing seeded storms; (iii) the analytical techniques used for detection of physical effects; (iv) the progress towards developing an effective hail suppression technique.

Finally, plans for the 1972 experiments will be discussed briefly.

AN AERODYNAMIC MODEL FOR THE TUMBLING OF SPHEROIDAL HAILSTONES ABOUT A HORIZONTAL MAJOR AXIS

E. P. Lozowski and R. List

Many workers have invoked the hypothesis of tumbling about a horizontal major axis, to explain some of the observed symmetry of hailstone shell structure. In this paper we propose a possible mechanism whereby such motion may be established.

Wind tunnel measurements of the static drag, lift and torque acting on oblate spheroids are incorporated into a model of the aerodynamics of freely falling hailstones. A dynamic damping torque proportional to the angular velocity is also included. The hailstones are allowed three degrees of freedom; namely, translation in a vertical plane and rotation about a major axis which is normal to this plane. Two cases, I and II, are considered corresponding respectively to axis ratios of 0.50 and 0.67, terminal Reynolds numbers (with vertical minor axis) of 3.25×10^4, and 4.19×10^4, and Best numbers of 0.85×10^9 and 1.14×10^9. Initially the spheroid is falling at terminal speed with the minor axis vertical, when the motion is perturbed by a finite angular displacement. The equations of motion are then integrated numerically using a fourth order Runge Kutta method. The subsequent perturbation motion consists at first of a pitching motion accompanied by a horizontal oscillation. Depending upon the value of the non-dimensional damping coefficient, K, and the initial perturbation angle, the oscillation may either damp or amplify. If the energy source due to resonant coupling between the horizontal and angular oscillations exceeds the sink due to damping, the oscillation amplifies; if it is less, it damps. For K sufficiently large, all perturbations damp. For smaller K, small perturbations amplify and large ones damp, leading to neutral oscillations of constant amplitude. For still smaller K, all perturbations amplify until the spheroid flips over, and continuous rotation (tumbling) begins. Thereafter the rotational velocity increases until, after several hundred revolutions, a steady rotation occurs with a rate which may be as high as 0.02 rotations per diameter fallen. Also the mean fall speed is about 25 per cent higher than the terminal speed with the minor axis vertical, and horizontal translation is negligible. Values of K have not been measured yet; however, tumbling about a horizontal major axis has been observed for a spheroid in a vertical wind tunnel.

A HARMONIC ANALYSIS OF ATMOSPHERIC ELECTRICITY PARAMETERS

Bhartendu

Amplitude coefficient in terms of the contribution to the variance, and phase coefficient in terms of the time of maxima of the electrical potential gradient and positive and negative conductivities at seven land stations are computed and the diurnal, semidiurnal, terdiurnal and quartodiurnal frequencies are studied. Comparison is made between the potential gradient and conductivity results for individual months and the whole year. Air-earth current density was calculated by an indirect method and its harmonic coefficients are also studied. Harmonic and power spectral results are compared.

THE ELECTRIFICATION OF A TNT EXPLOSION CLOUD

D. R. Lane-Smith

The explosion of 500 tons of TNT in July 1970 at Suffield, Alberta, produced a cloud which rose to 8,000 ft in 2 minutes.

16-mm and 35-mm cameras at different sites recorded the cloud growth to give reliable figures for the cloud height and position. Field mills in the ground at positions ranging from 800 m to 6 km from ground zero recorded the changing pattern of electric field as the cloud became electrically charged. Later, the cloud drifted down the line of field mills depositing a fine dust as it went.

Numerical analysis of the results clearly shows: a) the development of an electric dipole in the cloud with charge magnitudes of the order of 10^{-1} coulomb; b) the screening of that dipole by conduction with a relaxation time of the order of 5 min; and c) the later precipitation of negatively charged dust in a vertical column about 1 km in diameter of very low conductivity surrounded by a cylindrical screening charge.

Some ideas regarding the physical processes occurring to produce the phenomena observed and the magnitudes measured will be put forward.

A LINEAR ACCELERATOR FOR WATER DROPS

J. D. McTaggart-Cowan and R. List

A linear accelerator for water drops has been constructed which will continuously accelerate a stream of large drops to their terminal velocity in less than four metres of fall. The device augments the acceleration due to gravity by aerodynamic means: the drops are directed to pass through a series of miniature inverted wind tunnels. The resulting drops are relatively uncharged and free of severe oscillations. This device was developed for collision experiments.

SESSION 9: Micrometeorology

SOLAR RADIATION ABSORPTION IN ICE AND WATER

R. Gilpin

Solar heating has an important effect on the temperature structure of lakes and in particular on the clearing of ice from lakes in the spring. The absorption of solar radiation effectively produces a distributed heat source within the water. The normal Beer's Law for absorption of radiation is not a good approximation for water because of the strong dependence of absorption coefficient of water on wavelength. It was found that the heat source in water could be modelled by a power law of the

form $\dot{R} = aL^{-\alpha}$. The constants in this expression were obtained by three methods. They were calculated from measurements of the absorption coefficient, from the transmitted flux at various depths, and from the rate of rise of the water temperature as a function of depth. For pure water subjected to solar radiation the values obtained were $a = 0.04\ I_0$, where I_0 is the incident flux, and $\alpha = 0.82$ when L is in cm. With these constants the power law expression fits the measured values to within 20% over the depth range $0.1 < L < 1000$ cm.

As well, a horizontal layer of water with fixed upper and lower surface temperatures was heated by simulated solar radiation. The temperature profile and the stability of such a layer was studied for various radiation fluxes and surface temperatures.

CALIBRATION AND TESTS OF A YAW SPHERE-THERMOMETER SYSTEM FOR SENSIBLE HEAT FLUX MEASUREMENTS

D. Yap, T. A. Black, T. R. Oke, and R. Wilson

A yaw sphere-thermometer assembly, to measure sensible heat flux by the eddy correlation method, was built following the design of Tanner and Thurtell. Wind tunnel experiments indicate that the sphere constant is significantly less than the theoretical value of 9/4.

Field tests were made over an extensive grass surface. The yaw sphere results are compared with those obtained from energy balance/Bowen ratio measurements for a four-day period. In general, there was satisfactory agreement between the two methods.

DATA ACQUISITION SYSTEM FOR EDDY FLUX MEASUREMENTS

J. L. Honsaker, F. McDougall, D. Oracheski

A system for storing turbulent flux data in digital form at high acquisition rates has been developed using a NOVA 1200 minicomputer with 8192 words of memory and a 9-track digital magnetic tape transport. Input is accepted from two independently clocked data sources, and stored on tape with records identifying each source. Labelling information and experimental parameters may also be recorded directly onto the tape.

The two data sources are: (1) up to 8 channels of turbulence data, e.g., from a sonic anemometer-thermometer and/or Fluxatron array — which are multiplexed and converted from analog to digital form at a total rate up to 16.8 kHz; and (2) a direct 16-bit parallel-data channel which is intended for a remote telemetry system having its own multiplexing. Four core memory blocks are filled alternately from these sources. Thus data can be accepted continuously, while being written as discontinuous records on the tape. A number of computational procedures can be performed on the data, either on- or off-line, using the same hardware.

THE RELATIONSHIP OF THE POSITION OF ATMOSPHERIC THERMAL STRUCTURES TO THE POSITION OF HEAT SOURCES ON THE SURFACE

R. M. Holmes

The lowest layers of the atmosphere are in a constant state of dynamic exchange with the surface of the earth. The amount of heat which is transported away from the surface is a function of surface temperature and atmospheric mixing near the surface. A relationship is proposed between the location of thermal structures in the atmosphere and heat patterns at the surface. It is proposed that the geometry of heat in the atmosphere is related to the heat geometry of the surface. The

degree of this association was determined over an irrigation oasis in Idaho during August of 1971. Two aircraft were staged so that synchronous observations were made of surface temperature (using a quantitative IR scanner) and heat flux in the lowest atmosphere (using an airborne instrument system). The degree of correlation between heated surfaces and heated air parcels was higher the nearer the surface the observations were taken (below 500 ft). At higher levels (above 500 ft), the position of the heated air was not correlated to the location of the surface heat source in this study area. However, large heat sources such as those encountered around the irrigation oasis near Twin Falls, had pronounced effects on the areas of strong atmospheric heat flux to over 2000 ft above ground level.

MICRO-SCALE PRESSURE SIGNATURES FROM STORMY WEATHER SYSTEMS

M. J. Curry and R. C. Murty

Efforts are being made to investigate mechanical processes in storm cells via remote sensing of micro-scale variations in atmospheric pressure at ground level. A network of three accurately matched microbarographs provides continuous records of pressure changes having amplitudes of a few tens of microbars and periods between 3 and 30 minutes at sites separated by about 4 km. Digital cross-correlation techniques and power spectrum analysis reveal the frequent occurrence of oscillations at periods suggestive of tropospheric acoustic-gravity waves whose sources are sought in nearby weather systems. Preliminary results suggest that unique pressure signatures are associated with certain types of storm systems and that a detailed study of these signatures can provide information about flow patterns within such systems.

Added in proof:

ACCUMULATION STUDIES IN NORTHERN ELLESMERE ISLAND

K. E. West, G. Hattersley-Smith and H. R. Krouse

In May 1970, samples of H_2O^{18}/H_2O^{16} analysis and stratigraphic data were collected from a 7 m deep pit and 22 m core-hole (total depth 29 m) at an elevation of 1800 m on the ice cap northwest of Tanquary Fiord, Northern Ellesmere Island. The mean δH_2O^{18} value of over 250 samples of the pit and core was -28.7 ‰ SMOW with extreme values of -22 and -37 ‰ SMOW. The stratigraphic studies indicate a mean annual accumulation of about 14.0 cm H_2O/yr for the pit while spectral analysis of the isotopic data suggests a higher annual accumulation of 19.7 cm H_2O. The consistent periodicity of the isotopic data is striking particulary in view of the discrepancies with stratigraphic interpretations.

When compared to meteorological data from the Upernivik station of central-west Greenland, the isotopic data indicate that these two areas have experienced the same major climatic trends for the past 45 years. However, with available data, we have been unable to correlate annual isotopic variations in Northern Ellesmere Island and similar studies done on the Greenland Ice Cap. It would seem while they experience the same long term climatic variations, annual isotopic variations are indicative of local climatology.

Stratigraphic and isotopic data also reveal that ice lens and pipe structures are very localized phenomena.

CANADIAN METEOROLOGICAL SOCIETY

6th Annual General Meeting, May 31, 1972
University of Alberta

AGENDA

The President in the Chair

1. Minutes of the 5th Annual General Meeting, May 12, 1971

2. Reports of the Executive Committee
   - (a) Annual Report of the Society
   - (b) Treasurer's Report
   - (c) Nominating Committee Report
   - (d) Editor's Report
   - (e) Awards Committee Report

3. Reports from Local Centres

4. Budget for period 1 January 1973 to 31 December 1973

5. Membership Fees

6. Amendments to Constitution and By-Laws

7. Other Business

8. Installation of Officers

CANADIAN METEOROLOGICAL SOCIETY

DRAFT MINUTES
CANADIAN METEOROLOGICAL SOCIETY*

Minutes of the Fifth Annual General Meeting of the Canadian Meteorological Society held at McGill University, Montreal, Quebec, Wednesday, May 12, 1971, at 8:00 p.m.

1. Minutes of the 4th Annual General Meeting of the Canadian Meteorological Society held June 17, 1970 at the University of Manitoba, Winnipeg, Manitoba.

Professor Hitschfeld moved that the minutes of the 4th Annual General Meeting be approved. Seconded by A. Parry. Carried.

2. Reports of the Executive Committee

(a) Annual Report of the Society
The President, Mr. D. N. McMullen, presented the Annual Report and answered questions arising.

(b) Treasurer's Report
The Treasurer's Report was presented by M. S. Webb who moved that the report, as published, be approved. Seconded by E. J. A. Hamilton. Carried.

(c) Nominating Committee Report
The report was presented by G. A. McPherson who noted that since the report had been approved by the executive and no further nominations had been received the following would be declared elected to office for 1971-72:

Executive	President	Mr. C. M. Penner
	Vice President	Mr. G. A. McKay
	Treasurer	Mr. M. S. Webb
	Corresponding Secretary	Mr. G. A. McPherson
	Recording Secretary	Mr. A. H. Campbell
	Editor	Mr. E. J. Truhlar

Councillors at Large
Mr. J. L. Knox
Dr. C. East
Mr. S. V. A. Gordon

Auditor Mr. R. D. Easto

(d) Editor's Report
Mr. E. J. Truhlar, editor of ATMOSPHERE, presented this report. In response to questions he outlined the publicity campaign about to be launched by the University of Toronto Press on behalf of ATMOSPHERE. Prof. W. Hitschfeld moved a vote of thanks to Mr. Truhlar and his staff for their efforts on behalf of ATMOSPHERE. Seconded by I. D. Rutherford and carried unanimously.

(e) Report of the Awards Committee

Mr. D. N. McMullen presented the report which had been approved by Council. The awards were as follows:

Dr. R. E. Munn, Canadian Meteorological Service, Toronto - The President's Prize for his important work and contributions to micrometeorological and environmental problems and particularly his book "Biometeorological Methods".

N. Yacowar, Canadian Meteorological Service, Montreal - The Prize in Applied Meteorology, for his work on developing the objective temperature forecast procedures now in operational use in the Canadian Meteorological Service.

N. A. McFarlane, McGill University - The Graduate Student Prize, for the valuable work on atmospheric stability incorporated in his M.Sc. thesis "An Eigensystem Study of the Stability of Atmospheric Zonal Flows".

J. A. Fitzgerald, University of New Brunswick - The Dr. Andrew Thomson Undergraduate Student Prize, for his work on evaluating forecast accuracy incorporated in his papers "Errors in Temperature Forecasts for the Atlantic Provinces" and "Evaluation of CAO Baroclinic QPF for the Atlantic Provinces".

The President then presented the prize in Applied Meteorology to Mr. Yacowar, and a letter to Mr. N. A. McFarlane indicating that his prize had been ordered. The other award winners were not present.
M. K. Thomas moved a vote of thanks to Dr. J. Clodman and his colleagues on the Awards Committee. Seconded by Dr. Brewer. Carried unanimously.

3. Reports from Local Centres

Reports from the following local centres were presented:

British Columbia Centre	Dr. T. A. Black
Alberta Centre	Dr. P. W. Summers
Regina Centre	Mr. S. J. Buckler
Winnipeg Centre	Mr. E. H. V. Dexter
Toronto Centre	as published
Ottawa Centre	Mr. W. F. Ganong
Montreal Centre	Dr. I. D. Rutherford
Quebec Centre	as published
Halifax Centre	as published

One common theme that ran through the above reports was the appreciation of the members for the speaking tour carried out by Dr. F. K. Hare earlier in the year. The hope was expressed that similar tours would continue to be co-sponsored by the Society.

4. Budget for the Year 1972

The budget was presented by Mr. M. S. Webb who moved that it be approved. Seconded by Dr. A. J. Robert. After considerable discussion and explanation of details the motion was carried unanimously.

5. Membership Fees for 1972

It was moved by G. A. McPherson and seconded by Dr. Bhartendu that Society membership fees for 1972 remain unchanged from the present structure.
Professor Hitschfeld moved an amendment to the motion viz., that membership fees be raised by the amount of $2.00 in every category. Seconded by Mr. D. E. McClellan. The amendment was defeated. The original motion was then carried by a majority vote.

6. Sustaining Membership in SCITEC

M. K. Thomas moved that the Society pay SCITEC a sum corresponding to ten cents per member as of June 1, 1971, as a sustaining membership fee for the year 1971. Seconded by Dr. P. E. Merilees. After considerable discussion regarding SCITEC's aims and objectives the motion passed with only one member opposed.

7. Location of 6th and 7th Annual Congress

Mr. D. N. McMullen announced that the 6th Annual Congress of the Society will be held in Edmonton on May 31, June 1 and June 2, 1972.

Mr. E. F. Caborn moved that the 7th Annual Congress be held in Halifax in 1973 with the Halifax Centre acting as host. Seconded by Mr. B. Adamson. Carried, with thanks to the Halifax Centre.

8. Other Business

(a) Professor Hitschfeld moved a vote of thanks to the Nominating Committee; this motion was passed unanimously by the meeting.

(b) Moved by Professor Hitschfeld, seconded by M. K. Thomas that Council instruct the Nominating Committee of the 1972-73 Executive to consider re-implementing the principle established earlier of rotating the executive among suitable centres or combinations of centres in Canada. Carried.

(c) It was moved by Dr. G. McBean that the executive consider the establishment of committees to aid in communication and coordination between various groups involved in research in Canadian meteorology. Seconded by Dr. M. Miyake. The motion was passed by a vote of 22 to 13.

(d) A vote of thanks to the outgoing executive was moved by M. D. Hewson and seconded by Dr. A. Brewer.

9. Installation of Officers

Mr. McMullen welcomed the new members of the 1971-72 Council and turned the meeting over to the incoming President, Mr. Penner.

10. Adjournment

The meeting was adjourned at 10:20 p.m.

*All reports referred to in these minutes were published in full in the Special Congress Issue of Atmosphere, April 1971, and mailed to all members prior to the 5th Annual General Meeting.

ANNUAL REPORT

PRESIDENT'S REPORT

THE ROLE OF THE SOCIETY

The years 1971-72 were important years in developing the direction and the role of the Society. The standing committees on Public Information, Scientific and Professional Matters and Centres and Chapters are gradually developing their roles and have been active.

Atmosphere is becoming a substantial publication and should soon reach maturity. The Society has supported the Youth Science Foundation and SCITEC. Both of these organizations are in need of more support and the role the CMS will have in such activities must be reassessed. We might well have wished to move faster in many areas but for a small society with small financial resources and no paid secretariat, I believe the results to date are encouraging.

FINANCIAL MATTERS

The Society operated at a deficit partly due to the expenses of setting up Atmosphere as a regular journal. The Society is almost unique in trying to publish a professional journal without outside grants or subsidies. Recognizing that with increasing costs of publication the future of Atmosphere might well be dark, the executive renewed its application for a small grant of $3000 per annum from the Atmospheric Environment Service. We hope this application will succeed. The AES also will order multiple subscriptions to Atmosphere to supply its various needs. Such a grant, along with a substantial increase in our subscription list, would stabilize the financial situation of the Society allowing it to develop and to promote meteorology in Canada in many ways such as financial assistance to Centres, educational projects, SCITEC, Youth Science Foundation, Science Fairs, etc.

ATMOSPHERE

The decision taken at the 4th Annual Congress in Winnipeg in 1970 has been implemented. Atmosphere is growing and healthy. With continued support from the meteorological community in Canada it will continue to improve. We have launched the publication and have obtained a considerable response from libraries and universities. Our request for a grant from the Atmospheric Environment Service is based, in part, on the fact that Atmosphere is the only Canadian Journal of Meteorology which provides an essential forum for Canadian meteorologists as wel as a medium of communication with other professions. There have already been some excellent contributions by notable Canadian meteorologists this past year. Thus we have a real commitment to make Atmosphere succeed, a commitment to which all meteorologists in Canada must subscribe. With increasing attention bein paid to the quality of our environment, professional meteorology must have a voice

OTHER SOCIETY ACTIVITIES

The CMS speaker's tour sponsored by the AES was undertaken this year by Profes Maurice Danard of the University of Waterloo. The tour was a tremendous succes

and the Society would like to thank Dr. Danard for the excellent presentations and discussions.

Some of the Centres featured meetings this past year on environmental problems and pollution which were popular types of lectures attended by large numbers of the general public. This stimulation of public interest by meaningful but popular discussions is, or should be, a very important function of the Society.

MEMBERSHIP

Our membership rolls now include:

General Members	480
Sustaining Members	2
Student Members	77
Subscriptions to Atmosphere	78

The total membership has not changed significantly over the past few years.

The executive is recommending to the membership-at-large the adoption of the following fee structure for 1973:

Members	$15.00
Student Members	$ 7.50
Sustaining Membership	$50.00

The increase in the Student Membership fee is necessary and will almost pay the actual membership costs plus the cost of Atmosphere. The nominal increase in the General Membership fee merely covers increased postal and general costs.

LOCATION OF THE EXECUTIVE

The Nominating Committee report has laid the groundwork this year for possible moves of the executive to other locations.

BY-LAWS

The executive recommends to the membership-at-large adoption of the two proposed by-law changes.

By-Law #2(c) and 2(d)

The existence of both corporation and sustaining memberships was confusing and not useful.

By-Law #6(f) and Article 4 of the Constitution

This amendment gives the executive power to nominate an editor. The executive will be in a better position to nominate the editor than an ad-hoc nominating committee. The editor, at the request of the executive, could continue to serve on the executive in a consultative capacity even though he would not continue as an official member of the executive committee.

NOMINATING COMMITTEE REPORT

As Chairman of the Nominating Committee in accordance with By-Law 4 of the By-Laws of the Canadian Meteorological Society the following names are submitted in Nomination for Council for the Year 1972-73.

All nominees have been contacted and have given their consent to accept the office if elected.

There appears to be no reason why the executive cannot be moved through various larger Centres and the attached slate of officers will assist a move of the executive to Montreal in 1973-74.

For 1972-73 CMS

President	G. A. McKay
Vice-President	W. H. Hitschfeld
Past President	C. M. Penner
Treasurer	M. S. Webb
Corresponding Secretary	G. A. McPherson
Recording Secretary	C. B. Adamson
Editor	E. J. Truhlar
Councillors-at-Large	S. J. Buckler
	J. F. Derome
	L. E. Parent

S. V. A. Gordon
Chairman, Nominating Committee

AWARDS COMMITTEE REPORT

Recommendations of the 1971 Awards Committee:

The Presidents Prize: Drs. M. Kwizak and A. Robert
for their work published as: "A semi-implicit scheme for grid-point atmospheric models of the primitive equations." Monthly Weather Review, Vol. 99, 1971.

The Prize in Applied Meteorology: J. S. Marshall
for his work published as: "Peak-readings and thresholding in processing weather radar data." J. of Appl. Meteorol. December, 1971.

Graduate Student Prize: R. S. Schemenauer
for his work, described in his MSc thesis at the University of Toronto: "Measurement of the Drag Coefficients and Characteristic Motions of Snow Crystal, Graupel and Small Hail Models" and subsequently published in the J. of Atmos. Sci. January, 1971 by List and Schemenauer under the title "Free-Fall Behavior of Planar Snow Crystals, Conical Graupel and Small Hail."

The Dr. Andrew Thomson Undergraduate Student Prize: Mr. Tom Low
Mr. Low is an undergraduate student at the University of Toronto. His award is for a BSc thesis in 1971 in the Faculty of Applied Science and Engineering, "A Study of Collisions between Raindrops and Metal Chaff."

K. L. S. Gunn, Chairman

CANADIAN METEOROLOGICAL SOCIETY
STATEMENT OF RECEIPTS AND EXPENDITURES
FOR THE YEAR ENDED DECEMBER 31, 1971

BANK ACCOUNT

RECEIPTS			
	Dues 1970	$ 48.00	
	Corporate Membership	80.00	
	AES Grants	500.00	
	Dividends & Interest	66.96	
	1971 Congress	1,157.02	
	Atmosphere Sales	485.25	
	Atmosphere Reprints	278.95	
	TOTAL RECEIPTS		$2,616.18
EXPENDITURES			
	Prizes	$ 100.00	
	Supplies	391.99	
	Atmosphere Vol 8 #4	1,000.00	
	Publicity Campaign	831.48	
	Centres	230.45	
	Micromet Conference	114.76	
	Bank Charges	10.00	
	SCITEC - Grant	50.00	
	- Other	81.50	
	Y.S.F. - Grant	50.00	
	Auditor	30.00	
	Atmosphere's Account	125.00	
	1972 Congress	100.00	
	TOTAL EXPENDITURES		$3,115.18
	Bank Balance - January 1, 1971	$2,567.69	
	Plus Receipts 1971	2,616.18	
	Less Expenditures 1971	3,115.18	
	Bank Balance - December 31, 1972	$2,068.69	

UNIVERSITY OF TORONTO PRESS ACCOUNT

RECEIPTS

Dues:	January	$ 119.00		
	February	2,699.30		
	March	1,810.45		
	April	694.00		
	May	1,222.00		
	June	556.58		
	July	282.00		
	August	212.00		
	September	98.00		
	October	136.00		
	November	168.00		
	December	94.00		
Tax Rebate			$8,091.33	
			8.40	
		Total Receipts		$8,099.73

EXPENDITURES

Commission (20% of $8,091.33)	$1,618.27	
Atmosphere Vol 9 #1	2,305.96	
#2	1,786.13	
#3	1,521.50	
#4	1,791.20	
Cover Design	312.00	
Congress Atmosphere	1,147.14	
Congress Mailing	152.29	
Total Expenditures		$10,634.49

Balance Jan. 1/71	000.00
Plus Receipts 1971	8,099.73
Less Expenditures 1971	10,634.49
Balance Dec. 31/71	2,534.76

CANADIAN METEOROLOGICAL SOCIETY
BALANCE SHEET AS OF DECEMBER 31, 1971

Assets

Bank Balance - December 31, 1971	$2,068.69	
Bonds - Canada Savings - Series #24	950.00	
Accrued Bond Interest - (a)	142.50	
Bell Telephone - 12 shares at $46.00	552.00	
Total Assets		$3,713.19

Liabilities

U of T Press Account		$2,534.76	
Surplus December 31, 1970	$4,088.19		
Deficit for year 1971	2,909.76	1,178.43	$3,713.19
Note (a) Bond Interest - 1970 - 7% of $950		66.50	
- 1971 - 8% of 950		76.00	
		$ 142.50	

AUDITOR'S REPORT

I have examined the records of the Canadian Meteorological Society and am satisfied that the Treasurer's Report presents a proper statement of the financial position as at December 31, 1971.

R. D. Easto,
Auditor.

STATEMENT OF ACCOUNTS FOR ATMOSPHERE
YEAR ENDED 31ST DECEMBER, 1971

INCOME		EXPENDITURE	
Subscriptions	$ 32.18	Postage	$ 180.55
Reprints	39.75	Printing	974.91
CMS Subsidy	1125.00	Typing	28.50
	$1196.93	Bank Charges	5.00
			$1188.96
Current Account 1 January 1971	125.43	Current Account 31 December 1971	133.40
	$1322.36		$1322.36

Anthony W. Smith
March 1st. 1972

EDITOR'S REPORT - ATMOSPHERE 71

The year 1971 marked the transition from the old to the new Atmosphere, a handsomer and more expensive publication. Following the mandate given by the members at the 4th Annual General Meeting at Winnipeg, the Society contracted with the U of T Press for their services to print and distribute each issue and to bill members and institutions annually. This total service has strained the Society's finances. However, this situation was not unexpected and had been discussed in May 1971 at the Annual Meeting in Montreal where members had suggested that the journal must be given a good chance to grow and develop in its new format for several years. In addition, any sudden changes in concept, e.g., fewer issues or changes in distribution and management procedures after a short time of operation under the new set-up would be unfair to the institutional subscribers — especially the new ones who had been added to the Society lists in response to the special promotional campaign.

The new look has gained favourable comments. The clever and distinctive cover along with the professionally designed and produced interior (typeset in Times Roman) has enhanced the presentation of papers and articles. In addition the quality of articles has been improving. The article by M. K. Thomas ("A Brief History of Meteorological Services in Canada") commissioned by the Executive to honour the centennial of the Canadian Meteorological Service was very interesting and has been well received.

Five issues of Atmosphere (including the Congress issue) were published in 1971 and these contained 9 articles, 4 Book Reviews, 9 Reports, 13 Announcements, 5 notes, 5 letters, a few other news items along with the Congress program and abstracts and the CMS annual reports. The regular issues ran to 140 pages, while the Congress issue was the largest ever at 60 pages to include the program and abstracts for the 2nd Can. Conf. on Micrometeorology, co-sponsored by the CMS.

Suitable papers are no longer in short supply. Out of 18 contributions reviewed for publication in 1971, 9 were published, 5 were rejected, 2 were considered too long for adequate publication, and 2 were sent back to authors for revision. By the end of 1971, 3 papers had also been accepted for the Vol. 10 No. 1 issue and another was accepted with revisions; 3 books are out for review. (In 1972 two articles have been accepted, 1 received for review, and 3 are promised for submission.) There is a backlog of almost an issue. The distribution of issues at the end of the year was about one month behind schedule.

Several optimistic forecasts regarding an increase in the number of new subscriptions did not materialize. The number of members decreased by 38; student memberships and institutional subscriptions increased by 20 and 46, respectively. Thus the actual total at the end of 1971 was in effect slightly higher than that for the previous year.

The promotional campaign initiated in April was disappointing and only resulted in an increase of 46 subscribers (over the original 32). Even extrapolated to the end of a 3-year period this falls wide of the mark of 400 new subscribers which were hoped to be gained from North American Colleges, Universities and Libraries. Perhaps the $10 subscription fee was too high — even $8 was considered fairly high when the U of T officials were first contacted.

The original cost estimate to print 1000 copies of a 32-page issue was (and has remained) at $1306. Authors' alterations and engravings for diagrams and photographs were expected to cost an extra $100 each (for a total of $200) for each issue. However, some issues have required about twice this extra cost, i.e., $400. Thus two issues have each cost nearly $1700 to produce. Atmosphere has

too small a press run (1000) to make use of photo-offsetting techniques for printing which is more economical for reproducing diagrams and photographs. The printing is by letterpress.

The U of T Press charges 20% of the subscription fee for maintaining the mailing lists and for collecting the annual fees. Corporate and Sustaining Members are billed separately by the Society but receive publications through the complimentary mailing list.

Several proposals have been made to obtain more revenue, including: printing only 4 issues per year; instituting page charges; raising annual membership fees (especially for Student Members); obtaining grants; selling bulk-lot issues to AES; etc. It is virtually certain that the U of T Press will obtain a computer controlled photo-typesetting system to improve their operations. This new system would likely help hold down the normal price increases for printing.

The sale of back issues of Atmosphere (although a non-recurring operation for individual subscribers) has been a bright spot as far as income is concerned. 11 sets have been sold or ordered at $50 a set. Since Librarians don't like to have incomplete sets of journals on their shelves, they usually order back issues after subscribing to a new journal. Atmosphere, Vols. 1 & 2 (printed under the auspices of the RMS, Can. Branch), are out-of-print. Some thought should be given to reprinting these early volumes for sale at a profit by the Society after libraries on the subscription list have been contacted.

E.J. Truhlar

REPORT ON THE ACTIVITIES OF THE CMS STANDING COMMITTEE ON PUBLIC INFORMATION

The members of the Committee for 1971-72 were H. B. Kruger - Chairman; L. B. MacHattie; D. K. Smith; and Dr. T. A. Black. The following is an outline of the Committee's activities:

1. A memo was sent on 13 Sept. 71 to all CMS Centres drawing attention to "National Environment Week" (second week of October 1971).
2. A Committee meeting was held on Oct. 27, 1971 (made possible because of the AES Centennial Symposium) at which it was decided to:
   a) work towards the goal of "immediate response" to controversial items appearing in the press by developing a file of statements on a range of likely subjects;
   b) urge Centres to publicize meetings which might be of public interest, and develop inventories of members who would be willing to address various groups;
   c) assist in Annual CMS Congress publicity at the national level by preparing a news item for release to the media shortly before the Congress opening date;
   d) attempt to start a suitable file on Congress publicity activities to enable guidance to be given to Congress Program Committees;
   e) suggest to the Editor of Atmosphere that layman interest in the publication might be increased if "Weather Notes" - items on interesting weather events in Canada and similar topics, perhaps contributed by retired meteorologists - were included on a fairly regular basis.
3. An attempt (without success) was made to develop a suitable CMS response to a series of three articles by columnist John Schmidt on Alberta hail supression activities. These articles, which appeared in late October—early November 1971 in the Calgary Herald, contained some extremely critical comments about Canadian meteorologists.
4. An article entitled "CMS and Public Information" was published in Vol. 9, No. 4 of Atmosphere. It summarized Committee activities and called for membership help in establishing a 'statement' file.
5. A memo was sent to all CMS Centres on 21 Feb. 72 summarizing a Toronto Centre Public meeting on "The Environmental Crisis - Real or Imaginary" and recommending emulation by other Centres.
6. Dr. A. D. Christie agreed to write an article presenting a more rational view on the possibilities of weather control than was contained in a Reuter News Agency story of 4 Feb. 1972 quoting Dr. Werhner von Braun of NASA. Dr. Christie's article was distributed to 107 Canadian daily newspapers on 14 March 72 with a covering press release signed by CMS president C. M. Penner.
7. Discussions and correspondence were carried out with the CMS Annual Congress Chairman in relation to Congress publicity.
8. A final article on Committee activities has been prepared for the Vol. 10 No. 2 issue of Atmosphere. It contains background material on the 14 March press release, and also encourages members to contribute to the high school publication Science Affairs as a means of bringing meteorology to high school science students.

It is the hope of the Committee that it has made some worthwhile contributions to the establishment of a proper framework for future Society efforts in the important area of public information.

H. B. Kruger, Chairman
CMS Standing Committee on Public Information

REPORT OF THE STANDING COMMITTEE ON SCIENTIFIC AND PROFESSIONAL MATTERS

The Standing Committee examined the motion proposed at the 5th Annual General Meeting by Dr. G. A. McBean, seconded by Dr. M. Miyake, which read "that the Executive consider establishment of committees to aid in communication and co-ordination between various groups involved in research in Canadian meteorology", and presented the following recommendations:

1) The Committee in reviewing the matter with members-at-large was unable to find a sufficiently strong interest to warrant the establishment of committees to serve specialized research groups. It, therefore, recommends that no action be taken on this proposal.

2) It was, however, apparent to the Committee that there is a concern among the members for improved communication and greater involvement. In this regard the following are the Committee's suggestions:

a) That the members of the Society be made fully aware that the Executive is prepared, through its established committees or through the formation of ad hoc committees, to adjudicate or examine matters of professional or scientific concern brought to its attention by a member or members.

b) That communication among research or special interest groups be improved by encouraging such groups to arrange individual sessions, at the Annual Congress, given over to the presentation of their papers. This should be possible if the Program Chairman is given sufficient notice, say six months.

The Standing Committee has followed with interest the development of SCITEC during the past year. The magnitude and scope of the organization have created problems which will require some time to iron out. Attention is now being directed to a review and assessment of Volume 2, Targets and Strategies for the 70's, of the Senate Special Committee on Science Policy. It is hoped that the interest generated and the guidance given by this Report will further the development of SCITEC. It is the hope of the organizers of SCITEC that this organization will develop as a spokesman for the scientific community in establishing national scientific policies.

The recent request by SCITEC for an increased assessment of the founding societies was not favourably received by the Committee. It is felt that a more precise indication of the role of SCITEC, its policy and direction of action must be set out before an escalated contribution can be recommended to the Canadian Meteorological Society.

ANNUAL REPORTS FROM CENTRES

B.C. CENTRE

The officers of the B.C. Centre in 1971-72 were:

Past Chairman	Dr. T.A. Black
Chairman	D.A. Faulkner
Vice-Chairman	Dr. M. Miyake
Secretary-Treasurer	Wm. C. Thompson
Program Director	Dr. T. Oke
Member-at-Large	Dr. B. Sagar

A series of meetings was held as in past seasons with discussions on a wide variety of meteorologically related subjects. Speakers and topics were:

Dr. I.K. Fox - Director of Water Resources Research Centre, U.B.C., "Prospective Program of the New Water Resources Research Centre"
Mr. J.R. Marshall of the Climatology Sector, Canada Land Inventory, "Renewable Resources and Meteorological Requirements in British Columbia"
Mr. Wm. C. Thompson of the Vancouver Weather Office, "The Vancouver Airport Fog Dispersal Program"
Mr. J. Emslie of the Vancouver Weather Office, "Kamloops Pulp & Paper Co. Meteorological Study Into the Transport of Mill Stack Effluent"
Dr. M. Danard of Waterloo University, "The Role of Meteorology in the Environmental Management of a Watershed"

In March, an experimental series of three public lectures was held at the Vancouver Public Library. The series, suggested and organized by Dr. T. Oke, was entitled - "Our Atmosphere - What Are We Doing To It?"

The three speakers (as listed below) discussed the impact man is having on the atmosphere with particular emphasis on British Columbia climate. Mr. Bob Fortune, well-known weathercaster of CBC TV, Vancouver acted as host and moderator at each of the meetings.

Speakers and topics were:

Dr. R.W. Stewart, "The Effects of Water Management On Our Atmosphere"
Dr. T.R. Oke, "The Effects of Urbanization On Our Atmosphere"
Dr. T.A. Black, "The Effects of Forest and Agricultural Management On Our Atmosphere"

The series proved to be interesting and well attended suggesting these should be continued in future years.

A night at the H.R. McMillan Planetarium in late April finished off the season's activities.

ALBERTA CENTRE

Executive of the Centre for 1971-72:

Chairman	Mr. A. F. Ingall, Arctic Weather Central, AES, Edmonton
Secretary	Dr. J. M. Powell, Northern Forest Research Centre, Canadian Forestry Service, DOE, Edmonton
Treasurer	Mr. K. W. Daly, Edmonton Weather Office, AES, Edmonton
Calgary Member	Mr. D. Storr, Alberta Watershed Research Program, AES, Calgary

The Centre has had four meetings during the winter season. All have been held in the Henry Marshall Tory Building on the Campus of the University of Alberta, at the invitation of the Division of Meteorology, Department of Geography.

Unfortunately our first scheduled meeting, on October 6, on the topic "Education for Environmental Management" to be given by the internationally distinguished lecturer Professor L. J. Mostertman of the University of Delft, had to be cancelled at a late date.

On November 10, 1971, Mr. D. Storr, hydrometeorologist, AES, connected with the Alberta Watershed Research Program, gave an interesting talk on "Meteorological Problems and Progress in Watershed Research in Southern Alberta". Another feature of this meeting was the presentation of plaques to three of the ten recipients of Centennial Plaques awarded by the Western Region of the AES.

Dr. M. L. Khandekar, Division of Meteorology, Department of Geography, University of Alberta, discussed the topic "Discrete Vortex Representation of Atmospheric Motion with Possible Application to Tropical Cyclone Forecasting", on December 8, 1971.

Dr. M. Danard, University of Waterloo, distinguished lecturer sponsored by the Atmospheric Environment Service, showed his command of yet another area of meteorology, with his address on "The Role of Meteorology in the Environmental Management of a Watershed", on February 8, 1972.

Dr. E. Lozowski, a new member of the Division of Meteorology, Department of Geography, University of Alberta, spoke to the group on the topic "The Aerobatic Hailstone" on March 21, 1972.

During the winter, the Executive, with the addition of Dr. K. Hage and Mr. D. B. Fraser, have met periodically to plan the 6th Annual Congress of the Canadian Meteorological Society. We hope we have planned an interesting Congress.

REGINA CENTRE

The present Executive of the Regina Centre consists of Mr. S. J. Buckler, Chairman, and Mr. L. S. Meeres, Secretary, who have held office since the Regina Centre was organized in September, 1968.

The Regina Centre of the CMS had meetings during 1971, with speakers and subjects as follows:

February 1 - S. J. Buckler, OIC, Prairie Hydrometeorological Office

Topic - A Report on the 51st Annual Meeting of the AMS, San Francisco

February 18 - Dr. F. Kenneth Hare, University of Toronto

Topic - "Climate and Ecology in the Canadian North"

October 13 - Mr. M.S. Hirt, Air Quality Research Section, AES, Toronto

Topic - "Meteorological Applications to Air Pollution Studies"

December 1 - Dr. A.H. Paul, Dept. of Geography, University of Saskatchewan

Topic - "Economic and Social Effects of Weather"

On Thursday, February 10, 1972, a meeting of the Regina Centre was held at the Regina Campus of the University of Saskatchewan. The speaker was Professor Maurice Danard of the Dept. of Mechanical Engineering, University of Waterloo. His subject was "The Role of Meteorology in the Environmental Management of a Watershed".

The second meeting of the Centre for 1972 was held at the University on February 15th. The speaker was Mr. L.B. MacHattie of the Forest Fire Research Institute, Dept. of the Environment at Ottawa. His subject was "The Climates of Inclinations - a Discussion of Topographic Effects on Mesoclimate". During a brief business session at this meeting the Regina Centre elected by acclamation a new slate of officers to take office in the Fall of 1972. The new officers will be Chairman, Mr. D.A. Bernachi, Shift Supervisor at the Regina Weather Office, and Secretary-Treasurer Mr. David Frost, Dept. of Geography, University of Saskatchewan, Regina Campus.

The Regina Centre celebrated WMO Day on March 23rd with a special meeting at the University. In keeping with the international connotations of the day, and this year's theme for WMO Day, we were fortunate to have as our guest speaker Dr. Kurt Abrahamsson of the University of Umĕa, Sweden, who is currently Visiting Professor of Geography at the Regina Campus, U of S. His subject was "The Role of the Department of the Environment in Sweden with Particular Reference to Air Management in a Coastal City". Dr. Abrahamsson described the nature of the atmospheric pollution problems in Sweden, the government organization which has been set up to deal with these problems and the activities of that organization.

WINNIPEG CENTRE

The Winnipeg Centre followed the tradition of past years and once again enjoyed a very active season. Most of the meetings during the year were dinner meetings, which, on all occasions, proved to be popular.

The Centre has had excellent support from the Portage la Prairie CFB meteorological staff, and the first meeting of the year was held in the Officers' Mess, CFB Portage la Prairie, in October. The speaker was Dr. Robert Jones, Director of the Delta Waterfowl Research Station at Delta, Manitoba. He described the functions of the establishment, and then described some habits of migratory waterfowl, notably ducks and geese. He made attempts to relate migration habits to the weather.

The second meeting was held in November. Professor A. Bertels of the University of Manitoba Engineering Department described a system of wind deflec-

tors he designed to reduce the wind flow at ground level through outdoor facilities as large as a football stadium. Wind tunnel experiments on a model of the Winnipeg Stadium suggested that the system was practical.

The December meeting consisted of a panel discussion revolving around the use of computers and numerical products in various levels of operational forecasting. Mr. W. Gutzman of the Central Analysis Office, Montreal, and Messrs. D. McGeary, K. Fluto, M. Balshaw, J. Reid, and B. Crowe of the Prairie Weather Central participated in the panel. Discussion centred mainly on the operations of the National Severe Storms Forecast Centre, Kansas City, the Air Weather Service Global Weather Central, Offutt AFB, Nebraska, and the Central Analysis Office.

Mr. E. Robertson, Director of the Biomass Energy Institute, Winnipeg, warmed a cold January evening for members of the Society and their wives. He spoke on the current useage and depletion of our natural energy resources, which, he claimed, would soon result in an energy crisis. He described efforts of his organization to search for other sources of energy; in particular, the use of biological matter (biomass) as an alternative.

February guest of the Centre was Dr. Maurice Danard of the University of Waterloo, who spoke on the "Role of Meteorology in the Environmental Management of a Watershed". He outlined problems involved in the study of the water budget of the Okanagan Basin of British Columbia, and then described attempts to compute the average annual budget of the basin for use in planning for future development.

In observing World Meteorological Day, the Centre hosted Mr. S.J. Buckler of Regina as the guest speaker. His topic was the "Prairie Hydrometeorological Centre, Regina", of which he is Officer-in-Charge. Mr. Buckler described the various research projects undertaken by the Regina Centre.

April plans included a visit by Dr. J. Maybank of the Saskatchewan Research Council, Saskatoon. His subject was "Development of Meteorological Services in the Caribbean", in which he recently took a personal part.

Other plans of the Winnipeg Centre included participation in the Manitoba Schools Science Symposium in April, 1972. The Centre's role in this Manitoba-wide schools science fair was one of selecting outstanding meteorological entries, and providing special prizes to the entrants. It was hoped that the CMS participation would promote interest in meteorology in the Manitoba schools.

The Centre also issued a news release about World Meteorological Day, and encouraged Winnipeg news media interviews of meteorologists during the week of March 23. Response to this publicity attempt was modest but encouraging.

Plans were also made for a May windup to the season's activities - a visit and tour of the Whiteshell Nuclear Research Establishment of Atomic Energy of Canada at Pinawa, Manitoba.

The executive for the year was:

Chairman	Mr. C.D. Henry, Prairie Weather Central
Vice-Chairman	Mr. J.R. Lauder, Training Command HQ, CFB Winnipeg
Past Chairman	Mr. E.H.V. Dexter, Prairie Weather Central
Sec.-Treasurer	Mrs. P.G. Murray, Winnipeg Weather Office

TORONTO CENTRE

General

The Toronto Centre executive would like to take this opportunity to thank all those members who participated in our activities during this past season, in particular: Gordon McBean, Doug Whelpdale and Mike Newark.

Beginning with the first meeting in September, the Centre arranged for a meeting each month. Attendance at meetings was generally very good, for example, one had over 200 people.

It has become evident during the past year, that there were several areas of activity in which the Toronto Centre could and should increase their efforts. Three are listed here:

1. To communicate to the Centre membership ideas and information on current affairs which are meteorologically sensitive, (efforts in the past have generally been concerned with getting out notices of coming meetings). Some co-ordination between the National Executive and the various Centres should be arranged to implement such a program.
2. The public should be made aware, through the various channels of communication, of the importance of the atmosphere in topical environmental problems.
3. More encouragement and recognition should be given to members who spend extra time and effort in making the public and others more aware of the various aspects of our Society and of the importance of meteorolog

Meetings

This past year the executive of the Toronto Centre has tried to get as many people as possible interested in meteorology and especially in the activities of the Centre. To this end we have tried a number of innovations of which the first and foremost was to pick a theme for our series of speakers. We decided on the controversial subject of "Pollution of the Environment". Realizing that this was a subject that might all too easily interest only a small group of 'experts' in the field unless directed somewhat, we tried to cover a broad area of expertise and also instructed each speaker to be general in his remarks and avoid the use of undefined technical terms if at all possible. All complied with this suggestion and by April we have heard addresses by: Mr. Colin J. Macfarlane, Assistant Director of the Ontario Air Management Branch, concerning "Pollution, Prediction, Planning"; Mr. J.S. Sawyer, Director of Research, Meteorological Office of the United Kingdom, on the "Possible Effects of Human Activity on World Climate"; Dr. G.F. Shephard, Physics Dept., York University, about "The Atmosphere - Viewed from Below and Above"; Dr. H.G. McAdie, Assistant Director, Dept. of Physical Chemistry, Ontario Research Foundation, with regard to "Air Pollution R & D at the Ontario Research Foundation"; Dr. M.B. Danard, Dept. of Mechanical Engineering, University of Waterloo, concerning "Meteorology and Potential Water Pollution of the Okanagan".

As a highlight of the year, we had a panel discussion entitled "Environmental Crisis - Real or Imaginary?" This featured Mr. R. Keir, Information Officer, Ontario Dept. of the Environment, Mr. J. Bruce, Director, C.C.I.W., Dr. P.H. Jones, Chairman I.E.S.E., Mr. Tiny Bennett, journalist with the Sun, Mr. B. Kelly of Pollution Probe, University of Toronto, and Dr. P.D. McTaggart-Cowan, Executive Director, Science Council of Canada (moderator).

A field trip was arranged primarily to permit CMS members who work at the new A. E. S. Headquarters building to become familiar with their neighbour's work at the Connaught Labs. This was hosted by Dr. Ferguson, the Director.

We tried to get greater attendance at meetings by moving the meeting place around the city, by opening them to the public and making an all out effort to inform all people about our meetings, by encouraging members to bring their spouses to the meetings to make it more of a social affair, and by using a new notice format to attract more attention. Even though meetings were held in several locations around Toronto, the average attendance was 40 to 50. One meeting, however, in the AES Auditorium brought out 240 people. We also tried to involve our members more actively in the CMS by handing out a questionnaire to get their feelings on many aspects of the CMS. Eighty percent of those returning the questionnaire were willing to pay an additional $1.00 in support of Centre activities. A summary of the results of the questionnaire follows at the end of this report.

Not all of our ideas met with success but we hope that we have at least created some awareness of the CMS in the Meteorological Community around Toronto.

The Budget 1971-72

The bank balance left to this year's Executive at the end of the 1970-71 program was $23.19; we also received 85 x 5 cent postage stamps.

If we had had to buy CMS envelopes and mail out printed announcements for nine monthly meetings, our expenses would have been about $160 for the 1971-72 season. Fortunately, envelopes were donated by the National Office. This does not include expenses for out-of-town guest speakers such as the cost of taking a speaker to dinner. Announcements cost $7.58 per 600 copies. Most are distributed by hand in the Atmospheric Environment Service (H.Q., Regional Office and Weather Office) and at the University of Toronto. Postage amounts to about $7.00 per meeting to mail announcements to out-of-town-members, community colleges, news media, etc.

Actual Expenses to February, 1972

For the six monthly meetings from September '71 to February '72, we spent $31.15 for four announcements; $29.96 for postage; $11.97 for refreshments; $2.08 for letters sent by the Program Chairman; and 60 cents service charges for cheques. Receipts from coffee sales amounted to $8.41. $75.76 - $8.41 = $67.35. Our expenses have been much less than anticipated because other groups and persons have shared in, or elsewise supported some of our costs.

In November the National Executive provided $50 for our activities. We have also made a request for money to cover the costs for three meetings (March-May).

Results of Questionnaire

Approximately 200 questionnaires were mailed out to members of the Toronto Centre. Of that number, 69 were filled out and returned. The following is a summary of the results of the questionnaire. In answering each question, the member was allowed to make one or more choices. As a result the total percentage for each question can be greater than 100%.

Question 1 - Why do you attend CMS Meetings?

88% - appeal of topic, speaker	7% - social occasion
38% - to support Toronto Centre	3% - other

Question 2 - Why do you NOT attend meetings?

48% - other commitments
30% - topics uninteresting
20% - meeting places inaccessible
9% - late (or no) notification
7% - not interested

Question 3 - Which evening preferable?

38% - assortment
26% - Wednesday
20% - Tuesday
17% - Thursday
14% - Monday
3% - Friday

Question 4 - Where do you prefer meetings to be held?

45% - AES
35% - assortment
25% - U of T
13% - York University
7% - Science Centre
0% - Other

Question 5 - Do you intend to bring your wife? - Yes 49% No 51%

Question 6 - Indicate activities of Toronto Centre?

65% - scientific comment on environmental issues or correction of erroneous or misleading statement to public
61% - support of worthwhile ecological, environmental projects
45% - panel discussions
41% - informative talks to high schools, clubs, etc.
19% - tours
13% - sponsor activities such as science fairs
6% - CNE, Science Centre
6% - organize charter flights
6% - "stick to science"

Question 7 - Suggestions for Speakers or Topics

Speakers: - Monteith (Nottingham), Bryson (Wisconsin), Willett (MIT), Lee (DEMR), Summers (ALHAS), Dynamic Prediction Research (Montreal), Jack Davis, Nikleva (Vancouver), Robertson (Winnipeg), Treasury Board members, Pollution Probe, Laymen (what they expect from or think about meteorology).

Topics: - areas related to met.; overview of IFYGL; climatic modelling; pollution; ecology; environment; "Can weather be forecast?"; T.V. and radio weather; dynamic prediction; "local" mets. and their work; Provincial Departments of Environment, Health, Agric., Forestry; general reviews in related fields.

Tours: - Aerospace, Physics (York), CCIW, DOE and MOT (Ottawa)

Other: - sessions treated as interviews (1 or 2 questions, then audience)
- lounge meetings - weekly "Faculty Club" - 4:30 - 7:30 p.m.
- environmentalists nature club - canoeing

Question 8 - Are you in favour of annual banquet? - Yes 85% No 15%
Have you attended one? - Yes 70% No 30%

Question 9 - Are you willing to pay $1.00 in support of Toronto Centre activities?
- Yes 80% No 20%

Question 10 Will you attend business meeting? - Yes 72% No 28%

HALIFAX CENTRE

On June 16th, 1971, a meeting of the Halifax Centre was addressed by W. E. Markham, OIC, Ice Forecasting Central, who reported on the International Sea Ice Conference in Reykjavik in May, and described also his visit to Iceland from the tourist's point of view. At the same meeting, Elmer Caborn and Lyall Swansburg reported on the recent annual meeting of the CMS.

On October 5th, Mr. C.H. Sutherland spoke on the present and projected role of the Regional Superintendent of Scientific Services in the AES.

For a number of reasons, no further meetings were held until March 23rd, 1972, when J. A. McCulloch, AES, Toronto, spoke on Canadian participation in the International Field Year on the Great Lakes (IFYGL).

Two weeks later, on April 6th, Dr. Maurice Danard, University of Waterloo, presented a lecture on "Quantitative Precipitation Forecasting".

The original executive of the Halifax Centre for the current year was composed of A. P. Beaton, Chairman, and A. D. Gates, Secretary. With the move of Ice Central to Ottawa, Mr. Beaton was replaced as Chairman by R. A. Hornstein.

CANADIAN METEOROLOGICAL SOCIETY

Budget for 1973*

RECEIPTS

Fees - General	550 @ 14.00	$7,700.00	
- Student	100 @ 2.00	200.00	
- Sustaining	2 @ 40.00	80.00	
- Subscriptions	100 @ 10.00	1,000.00	
Atmosphere - sale of back issues		200.00	
			$ 9,180.00

EXPENDITURES

Atmosphere printing	20% of 8900	$1,780.00	
	4 @ 1700	6,800.00	
		8,580.00	
Congress Issue of Atmosphere		900.00	
Prizes		100.00	
Operating Costs of Executive		450.00	
Auditor		30.00	
Centres		300.00	
Grants - SCITEC		50.00	
- Y.S. Fair		50.00	
TOTAL			$10,460.00
BUDGETED DEFICIT			$ 1,280.00

* Your Executive is endeavouring to arrange with the Atmospheric Environment Service for the purchase of multiple subscriptions to Atmosphere and the provisio of a grant. If successful, the additional receipts should more than offset the deficit shown.

PROPOSED AMENDMENTS TO CMS CONSTITUTION AND BY-LAWS

January 31, 1972

Notice of Motion for Amendment to the Canadian Meteorological Society Constitution and By-Laws

1. Delete the office of Editor from the Executive in Article 4, Constitution of the Canadian Meteorological Society.

2. Change By-Law 6 Section (f) to read:

   An Editorial Committee shall be established, elected by Council and responsible to the Executive. Each member will normally remain on the Committee for at least two years. Atmosphere shall be an official publication of the Society and the Editor elected by Council shall be Chairman of the Editorial Committee. The Committee shall review annually the desirability of publishing other scientific reports, proceedings or journals and shall make recommendations to Council. All publications may be in either or both of the official languages of Canada.

Original Signed by Five Members of the Society

February 10, 1972

Notice of Motion for Amendment to the Canadian Meteorological Society By-Laws

1. Delete By-Law 2 (c) and 2 (d).

2. Add the following as By-Law 2 (c):

   Sustaining membership is open to individuals, institutions, companies, firms and organizations who wish to support the Society in promoting meteorology and its application for the benefit of Canada. A Sustaining membership will require a certain minimum annual contribution determined as indicated in By-Law 3.

Original Signed by Five Members of the Society

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 the 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 1972, 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.

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