

# CANADIAN METEOROLOGICAL SOCIETY

SECOND

ANNUAL

CONGRESS



MAY 07 1968

2ND ANNUAL CONGRESS

OF THE

CANADIAN METEOROLOGICAL SOCIETY

University of Calgary, Alberta  
June 3-5, 1968.

MONDAY MORNING  
JUNE 3, 9:00 AM

Welcome: Formal opening of the Congress

Announcements:

MONDAY MORNING  
JUNE 3, 9:10 AM

SYMPOSIUM ON THE UPPER ATMOSPHERE

Chairman: Dr. John B. Gregory, Institute of Space and  
Atmospheric Studies, University of Saskatchewan.

1. RECENT ADVANCES IN THE DYNAMICS OF THE UPPER ATMOSPHERE. C.O. Hines, Physics Department, (Aeronomy) University of Toronto. (45 min)
2. THE HEIGHT DISTRIBUTION OF OZONE AND  $O_2(^1\Delta)$  MOLECULES ABOVE 50 KM. E.J. Llewellyn and A. Vallance Jones, Institute of Space and Atmospheric Studies, University of Saskatchewan. (10 min)
3. ATMOSPHERIC ALKALI METAL STUDIES AT THE UNIVERSITY OF SASKATCHEWAN. H.N. Rundle, Institute of Space and Atmospheric Studies, University of Saskatchewan. (15 min)
4. ON THE VARIATION OF THE PHASE VELOCITY OF ANOMALOUS SOUND WAVES. E.R. Reinelt, University of Alberta. (To be read by title)
5. THE MEASUREMENT OF HORIZONTAL WIND MOTIONS IN THE ALTITUDE RANGE 50-120 KM USING RADIO TECHNIQUES. D.T. Rees, Institute of Space and Atmospheric Studies, University of Saskatchewan. (15 min)
6. SMALL-SCALE MOTION IN THE MESOSPHERE IN RELATION TO RADIO WAVE SCATTERING. J.B. Gregory, Institute of Space and Atmospheric Studies, University of Saskatchewan. (15 min)
7. COUPLING EFFECTS BETWEEN WINDS AND IONIZATION IN THE MESOSPHERE AND LOWER THERMOSPHERE (65-90 KM), CHRISTCHURCH, NEWZEALAND (44° S, 173° E), 1964. A.H. Manson, Institute of Space and Atmospheric Studies, University of Saskatchewan. (15 min)
8. THE FORMATION AND DISTRIBUTION OF NOCTILUCENT CLOUD. A.D. Christie, Meteorological Service of Canada, Toronto. (15 min)
9. METEOROLOGICAL SUPPORT FOR CHURCHILL RESEARCH RANGE OPERATIONS. B.L. Wetter and T.C. Hoopes, Pan American World Airways, Inc., Fort Churchill, Manitoba. (15 min)
- 9.5. OPERATIONAL ASPECTS OF THE COLD LAKE METEOROLOGICAL ROCKETSONDE PROGRAM. W.R. Fryers, Canadian Forces Base Cold Lake, Alberta.

MONDAY AFTERNOON  
JUNE 3, 2:00 PM

SYMPOSIUM ON THE TROPOSPHERE

SESSION I. TROPOSPHERIC CIRCULATION

Chairman: Dr. I.Y. Ashwell, Head, Department of  
Geography, University of Calgary.

10. A SIMPLE METHOD OF INCLUDING LONG-WAVE RADIATION IN A TROPOSPHERIC NUMERICAL PREDICTION MODEL. Maurice B. Danard, Department of Meteorology and Oceanography, Naval Postgraduate School, Monterey, California. (20 min)
11. ON THE STRUCTURE OF JET STREAMS. H.P. Wilson, Meteorological Service of Canada, Edmonton, Alberta. (15 min)
12. ON THE OROGRAPHIC DISTURBANCE OF THE TEMPERATURE AND MOISTURE FIELD OVER BRITISH COLUMBIA AND WESTERN ALBERTA. E.R. Reinelt, University of Alberta. (15 min)
13. NEW METHODS FOR DOUBLE THEODOLITE PIBAL EVALUATION. N. Thyer, McGill University. (To be read by title)
14. ROUND-OFF ERRORS IN UPPER WIND MEASUREMENTS. N. Thyer, McGill University. (To be read by title)

MONDAY AFTERNOON  
JUNE 3, 3:30 PM

SESSION II ARCTIC METEOROLOGY

Chairman: Dr. I.Y. Ashwell, Head, Department of  
Geography, University of Calgary.

15. (Title to be announced). Richmond W. Longley, University of Alberta. (45 min)
16. SYNOPTIC EFFECTS ON THE ENERGY BUDGET. E. Vowinckel and S. Orvig, McGill University. (15 min)
17. THE CLIMATOLOGICAL NETWORK OF THE YUKON. H.E. Wahl, Meteorological Service of Canada, Whitehorse, Yukon Territory. (15 min)
18. SNOW-DEVILS IN THE ARCTIC. D.B. Fraser, Meteorological Service of Canada, Edmonton, Alberta. (15 min)



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TUESDAY MORNING  
JUNE 4, 9:00 AM

SESSION III. ALBERTA HAIL STUDIES

Chairman: Dr. Walter Hitschfeld, Department of  
Meteorology and Physics, McGill University.

19. THE MICROBAROGRAPH IN THUNDERSTORM RESEARCH. R.C. Murty and M.J. Curry, University of Western Ontario. (20 min)
20. THE HAILSTORM RESEARCH PROGRAM AT MCGILL. R.H. Douglas and Walter Hitschfeld, McGill University.
21. ALBERTA HAIL STUDIES - A TEN YEAR REVIEW. Peter W. Summers, Research Council of Alberta. (20 min)
22. HAIL GROWTH IN A SINGLE-CELL STORM. Marianne English, McGill University. (10 min)
23. RADAR AND STEREO CLOUD PHOTO MEASUREMENTS OF AN ALBERTA HAILSTORM. A.J. Chisholm and C. Warner, McGill University. (15 min)
24. CLOUD STEREO-PHOTOGRAMMETRY FOR HAIL STUDIES. J. Renick and M. Balshaw, Meteorological Service, R.H. Douglas, McGill University. (15 min)
25. WIND MEASUREMENTS NEAR ALBERTA HAILSTORMS. N. Thyer, McGill University. (15 min)
26. HARPI: A NEW WEATHER RADAR DISPLAY. I.I. Zawadski and E. Ballantyne, McGill University. (10 min)
27. PRELIMINARY INVESTIGATION OF SULPHATES AND CHLORIDES IN ALBERTA PRECIPITATION. Peter W. Summers and Brian Hitchon, Research Council of Alberta, Edmonton, Alberta. (10 min)
28. A CHALLENGING EXPERIMENT IN APPLIED METEOROLOGY. D. Storr, Meteorological Service of Canada, East Slope (Alta.) Watershed Research Program. (10 min)

WEDNESDAY MORNING  
JUNE 5, 9:00 AM

SYMPOSIUM ON PHYSICAL METEOROLOGY

Chairman: Dr. Warren L. Godson, Superintendent of  
Atmospheric Research, Meteorological  
Service of Canada, Toronto.

29. PRECIPITATION PARTICLES AND SMALL-SCALE TURBULENCE. Roland List, University of Toronto. (15 min)
30. ICE NUCLEI IN FREE AIR AND IN PRECIPITATION. David Bishop and George Isaac, McGill University. (15 min)
31. THE CONCENTRATION AND ORIGIN OF NATURALLY OCCURRING ICE NUCLEI AT SASKATOON. R.S. Schemenauer, Meteorological Branch, Saskatoon and J. Maybank, Saskatchewan Research Council. (15 min)
32. ARTIFICIAL ICE NUCLEI FOR HAIL MODIFICATION. Gabor Vali, McGill University, Montreal. (15 min)
33. SOME SHORT-TERM, LOCAL INFLUENCES OF WIND DIRECTION ON ATMOSPHERIC ELECTRICITY AT GROUND LEVEL AT SASKATOON. J.E. Pakiam and J. Maybank, Saskatchewan Research Council, Saskatoon, Saskatchewan. (15 min)
34. OBSERVATIONS OF ATMOSPHERIC POTENTIAL GRADIENT AT METEOROLOGICAL RESEARCH STATION, TORONTO. Dr. Bhartendu, Meteorological Service of Canada, Toronto. (10 min)
35. TOTAL SOLAR RADIATION RECORDED IN MONTREAL AND IN THE COUNTRYSIDE. Dr. C. East, Observatoire de Geophysique, College Jean-de-Brebeuf, Montreal. (10 min)
36. THE THEORETICAL DISTRIBUTION OF DAILY CLEAR-SKY ISOLATION IN A MOUNTAIN BASIN AND ITS SEASONAL VARIATIONS. H.L. Ferguson, H.F. Cork, R.L. Andersen, S. Mastoris and B. Weisman, Meteorological Service of Canada, Toronto. (15 min)
37. TOPOGRAPHICAL VARIATIONS IN DIRECT SHORT-WAVE RADIATION INCOME AT MONT ST. HILAIRE, QUEBEC. B.J. Garnier and Atsumu Ohmura, McGill University. (15 min)



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WEDNESDAY AFTERNOON  
JUNE 5, 2:00 PM

SYMPOSIUM ON THE PLANETARY BOUNDARY LAYER

Chairman: Dr. G.T. Csanady, University of Waterloo,  
Waterloo, Ontario.

38. BOUNDARY LAYER COUPLING - A BRIEF SUMMARY OF RECENT PROGRESS AND PROPOSALS. Dr. Keith D. Hage, University of Alberta, Edmonton, Alberta. (45 min)
39. NUMERICAL SOLUTIONS FOR THE FLOW ABOVE A CHANGE IN TERRAIN ROUGHNESS. P.A. Taylor, University of Toronto. (15 min)
40. AIRBORNE TECHNIQUE IN CLIMATOLOGY AND HYDROLOGY OASIS EFFECT OVER PRAIRIE TERRAIN. R.M. Holmes, Inland Waters Branch, Department of Energy, Mines and Resources, Calgary, Alberta. (15 min)
41. SURFACE WINDS IN RELATION TO SLOPING TERRAIN. H.P. Wilson, Meteorological Service of Canada, Edmonton, Alberta. (To be read by title)
42. THE EFFECT OF MINOR RELIEF ON THE DISTRIBUTION OF PRECIPITATION. R.B.B. Dickison, Meteorological Service of Canada, Fredericton, New Brunswick. (10 min)
43. FREEZING PRECIPITATION AND ICE ACCRETION. G.A. McKay and H.A. Thompson, Meteorological Service of Canada, Toronto. (15 min)
44. THE CLIMATE OF THE CYPRESS HILLS: DESCRIPTION OF THE SITE AND PROBLEM. R.M. Holmes, Inland Waters Branch, Dept. of Energy, Mines and Resources, Calgary, Alberta. (To be read by title)
45. DIFFUSION AND DEPOSITION OF SMALL PARTICLES FROM AN ELEVATED INSTANTANEOUS POINT SOURCE. O. Johnson, Meteorological Service of Canada, Suffield, Alberta. (15 min)
46. DIFFUSION OF PARTICULATES FROM AN ELEVATED POINT SOURCE. J.A. McCallum, Meteorological Service of Canada, Suffield, Alberta. (15 min)
47. THE INTERACTION BETWEEN DAYTIME URBAN AND LAKE MESOSCALE CIRCULATIONS AT TORONTO. R.E. Munn, M. Hirt, B.F. Findlay, Meteorological Service of Canada, Toronto. (To be read by title)
48. DIFFUSION IN AN EKMAN LAYER. G.T. Csanady, University of Waterloo, Waterloo, Ontario.

A B S T R A C T S

2. THE HEIGHT DISTRIBUTION OF OZONE AND  $O_2(^1\Delta)$  MOLECULES ABOVE 50 KM

E.J. Llewellyn and A. Vallance Jones

Studies of the time variation of the infrared atmospheric bands emitted by oxygen excited to the  $^1\Delta$  level have led to the theory that such excited molecules are produced in the photolysis of ozone by solar ultraviolet radiation. This theory has made possible the prediction of height profile for the emission based on the best available measurements and estimates of the height distribution of ozone. Over the past 18 months three successful rocket measurements have been made of the height distribution of  $O_2(^1\Delta)$  molecules during the day. These agree well with the theoretical prediction within the limits of knowledge of the ozone height distribution. In the 80 - 90 km region there is, however, an enhancement of the  $O_2$  emission which implies either an unexpected enhancement of the ozone concentration at these heights, or a contribution from some other excitation mechanism. More accurate measurements of the ozone height distribution in the 60 - 90 km region are required to settle this question. It is very possible that measurements of the height distribution of the  $O_2$  emission may ultimately be the most accurate and convenient method of measuring ozone distributions in this height range.

3. ATMOSPHERIC ALKALI METAL STUDIES AT THE UNIVERSITY OF SASKATCHEWAN

H.N. Rundle

Twilight measurements of sodium and lithium densities have been carried out for several years and similar measurement of potassium densities have been made over a period of about one year. The sodium densities show seasonal variations and other variations that appear to correlate with stratospheric temperatures. The densities of lithium and potassium exhibit a less pronounced seasonal variation and artificially injected lithium appears to be an excellent tracer for large scale atmospheric motions at 85 to 90 km heights. The density distribution with height of sodium indicates that several mechanism are present, one of which is photochemistry.

4. ON THE VARIATION OF THE PHASE VELOCITY OF  
ANOMALOUS SOUND WAVES

E.R. Reinelt

Measurements made some 200-400 km to the west of a 500-ton explosion, set off at Suffield in 1964, indicate 10 to 15% variations in the phase velocity of anomalous sound waves returned to the ground from the mesosphere. Some of the smaller fluctuations can be accounted for by low-level variations of wind and temperature, but the larger variations are due to the sonic-fine-structure, e.g. sub-ducts, in the lower mesosphere.

Angles of descent deduced from the observed phase velocities range from 10 to 30 degrees at most recording sites, indicating that the pulses of sound energy must have travelled along different ray paths.



5. THE MEASUREMENT OF HORIZONTAL WIND MOTIONS IN THE ALTITUDE  
RANGE 50 - 120 KM USING RADIO TECHNIQUES

D.T. Rees

The most commonly used technique in the measurement of horizontal wind motions in the ionosphere is the so called closely-spaced receiver technique. The method consists of illuminating the ionosphere with a radio wave and observing the diffraction pattern formed on the ground by reflection, using three spaced antennae. Changes in this diffraction pattern are then interpreted in terms of movements in the ionosphere. In general, this method is only applicable to reflections from the regular E- and F-regions of the ionosphere, in the height ranges 110 - 120 km and 250 - 350 km.

The present paper will describe a method for the determination of wind movements in the D-region, over an altitude range of from 50 km up to 120 km. The technique employs the use of a powerful radio transmitter and a high gain, sensitive antennae and receiving system to record the weak, partial reflections that are obtained from the D-region. Consideration will be given to the experimental arrangement, the analysis necessary to deduce the wind parameters, the treatment of the data and their interpretation. It is hoped to present some mesospheric wind profiles obtained at Saskatoon over the above mentioned height range.

6. SMALL-SCALE MOTION IN THE MESOSPHERE IN RELATION TO RADIO  
WAVE SCATTERING

J.B. Gregory

The scattering of radio waves by weak inhomogeneities of refractive index, at altitudes between 50 and 120 km, has been extensively utilized for communication purposes. The nature of the scattering processes is not known with certainty. Evidence will be presented as to the temporal and altitude characteristics of the scattering regions, and the probable dynamical processes which establish the refractive index variations will be discussed.

7. COUPLING EFFECTS BETWEEN WINDS AND IONIZATION IN THE MESOSPHERE  
AND LOWER THERMOSPHERE (65 - 90 km); CHRISTCHURCH, NEW ZEALAND  
(44°S, 173°E), 1964

A.H. Manson

Earlier studies at Christchurch have established a correlation between the stratospheric cyclonic waves of the mid-latitude, eastward wind system ( $\approx 20$  km) and the periods of so-called "anomalous winter absorption" which are observed in the D-region (65 - 90 km).

Recently analysed data from the ionospheric drifts experiment and the differential absorption experiment have enabled a unique comparison to be made between winds and ionization in the D-region. The results indicate that there is a strong coupling between these two parameters. It is suggested that the distribution of ionization in the mid-latitude D-region is dominated by dynamic processes in years of low solar activity.



8. THE FORMATION AND DISTRIBUTION OF NOCTILUCENT CLOUD

A.D. Christie

Distributions of noctilucent cloud are studied in relation to the circulation of the lower atmosphere. The information available on water vapour abundance and on factors influencing it in the upper mesosphere is reviewed and a plausible model of noctilucent cloud genesis, consistent with it, proposed. Preliminary results of studies utilizing observational data are presented in support of the model.

9. METEOROLOGICAL SUPPORT FOR CHURCHILL RESEARCH RANGE OPERATIONS

B.L. Wetter and T.C. Hoopes

The main function of the Range Meteorological Section is the processing and application of forecast and observed wind data to meet safety requirements and satisfy scientific objectives relating to the launch of unguided rockets attaining altitudes of 40 to 600 miles.

Introductory notes include a brief history of meteorology in the Western Hudson Bay region from the early observations at Fort Prince of Wales to the present-day collection of upper atmospheric data by means of rockets and balloons. Some of the scientific experiments, international in scope and interest, are described, with special emphasis on support of the World Meteorological Rocket Network.

9.5. OPERATIONAL ASPECTS OF THE COLD LAKE

METEOROLOGICAL ROCKETSONDE PROGRAM

W.R. Fryers

Cold Lake, Alberta, is the site of one of the newest stations in the world-wide Meteorological Rocket Network and is the first regularly scheduled all-Canadian operation in this field of meteorology. Operational problems encountered in the first full year of operation are reviewed in this paper. A brief description of the Cold Lake operation is presented, with orientation slides. The accomplishments of the first year of operations are reviewed, detailing heights attained, parameters measured, and data yield. An analysis of deficiencies is made to classify causes attributable to sonde failure, radar faults, GMD faults, weather, supply problems, safety restrictions, techniques, and other reasons. These are further examined for possibilities of correction or otherwise. Finally, a run-down is given of current objectives for overcoming the deficiencies by improved facilities, training, hardware and techniques.

10.           A SIMPLE METHOD OF INCLUDING LONG-WAVE RADIATION IN  
              A TROPOSPHERIC NUMERICAL PREDICTION MODEL

Maurice B. Danard

A simple method of computing long-wave radiative cooling in the troposphere associated with water vapor has been devised. Radiation from ozone and carbon dioxide is not considered. However, influence of arbitrary vertical distributions of cloud and moisture are included.

Average annual cooling rates along a meridional cross-section have been calculated for a cloudless atmosphere. These results agree fairly well with the total radiative cooling (long- and short-wave) except in the lower troposphere at low altitudes. Here short-wave absorption by water vapor is appreciable.

Long-wave radiative cooling has also been computed in a case of a developing cyclone for comparison with release of latent heat. The largest cooling occurs at cloud top and can be a significant fraction of the amount of energy released as latent heat in the upper troposphere. Destabilization of the cloud mass and subsequent increase in precipitation may be important in cyclone development.

11.           ON THE STRUCTURE OF JET STREAMS

H.P. Wilson

An attempt is made to explain some of the observed features of jet streams as the result of a combination of dynamic instability and clear air turbulence in confluence zones.

12.           ON THE OROGRAPHIC DISTURBANCE OF THE TEMPERATURE  
              AND MOISTURE FIELD OVER BRITISH COLUMBIA  
              AND WESTERN ALBERTA

E.R. Reinelt

Mountain ranges lying athwart the flow produce not only disturbances in the velocity field, but also significant changes in the temperature and moisture fields. The Coastal Range and Rocky Mountains have a profound effect on the properties of Pacific air masses. Examination of upper air data for the summer months of 1963-65 shows that the deformation of the flow pattern is always accompanied by permanent changes in the thermal and moisture fields, whenever the lapse rate is other than dry adiabatic. The effect is found to be greatest for air masses which are initially quasi-saturated and unstable.

13.           NEW METHODS FOR DOUBLE THEODOLITE PIBAL EVALUATION

N. Thyer

Graphical methods are shown for determining the position of a balloon which is followed by two theodolites. They include new techniques applied to an old basic method, and also a completely new approach to the problem, using a coordinate transformation.



14. ROUND-OFF ERRORS IN UPPER WIND MEASUREMENTS

N. Thyer

When upper winds are calculated from data taken in the field, the round-off errors involved in recording the data can lead to spurious apparent fluctuations in the wind velocity. Examples of these are shown, and also a method of controlled smoothing to eliminate them.

17. THE CLIMATOLOGICAL NETWORK OF THE YUKON

H.E. Wahl

A review of the historical climatological network of the Yukon. Recent expansions in this network and events which have initiated this expansion. Climatological highlights reported to date. A discussion of the extremely low temperatures which have occurred in the Yukon Alaska basin including Snags North American record of  $-81^{\circ}\text{F}$ . The effect of elevation on minimum temperatures. The instrumentation required for the recording of extremely low maximum and minimum temperatures. Other suspected anomalies in published climatological data and charts. Proposed climatological sites to better define the climate of the Yukon.

18. SNOW-DEVILS IN THE ARCTIC

D.B. Fraser

The conditions under which destructive snow-devils have developed on the coast near Cape Parry are described. The formation of vortices in such circumstances may be explained in simple terms but the intensity is rather surprising.

19. THE MICROBAROGRAPH IN THUNDERSTORM RESEARCH

R.C. Murty and M.J. Curry

In recent years, the microbarograph has received considerable attention as a detector of pressure waves caused by nuclear explosions. Less well known, perhaps, are the potentialities of this type of instrument in meteorological research. This paper describes briefly a new type of microbarograph, designed for continuous operation, and shows its utility in thunderstorm research. The occurrence of periodicities in the pressure records associated with certain thunderstorms is pointed out, and it is suggested that these regularities may be due to acoustic-gravity waves generated through the mechanism proposed by Pierce and Coronoti (1966). A sample record in support of this suggestion is analyzed in detail.

20.

#### THE HAILSTORM RESEARCH PROGRAM AT MCGILL

R.H. Douglas and Walter Hitschfeld

Hailstorm research, begun in 1956, includes a program of data analysis and storm-modelling at McGill. Input to the model is supplied by Alberta field data on storm fallout, including the laboratory determination of its freezing characteristics; by the results of radar and photogrammetric analyses of the storm structure; and by wind- and temperature-soundings in the near vicinity of the storms. Output from model calculations include trajectories, sizes, and water/ice constitution of the hailstones. A model is emerging in which such parameters as available environmental thermodynamic energy and vertical wind shear, the in-cloud updraft profile, cloud- and rain-water content, and the temperature spectrum of freezing nucleus concentration all play important and interrelated roles.

21.

#### ALBERTA HAIL STUDIES - A TEN YEAR REVIEW

Peter W. Summers

After a successful pilot field study in the summer of 1956, the Alberta Hail Studies Project was formally set up during the winter of 1956/57. The three agencies providing funds and facilities are the Research Council of Alberta, the National Research Council and the Canadian Meteorological Service. The Stormy Weather Group of McGill University are responsible for the scientific direction of the project, and also carry out most of the data analysis.

The primary aim of the project is to determine the causes and behavior of hailstorms in Alberta, and devise models of hailstone growth as a sound scientific basis for experiments aimed at developing hail suppression techniques. From a very small beginning the project has increased in size and scope over the last ten years, to the point where it is now one of the largest and best equipped hail research studies in the world. The history of the project will be reviewed, and some of the more important scientific results to emerge over the years will be presented.



22.

## HAIL GROWTH IN A SINGLE-CELL STORM

Marianne English

Hailstone trajectories have been calculated as a means of evaluating models for at least one type of hailstorm found in Alberta. This type of storm apparently consists of separate and relatively small cells of short duration, with essentially vertical updrafts.

In our calculations, wide varieties of updraft profiles and liquid water concentration have been considered. For the former, we studied cases of updrafts constant with height, as well as situations when the updraft peaked at mid levels at values between 5 and 30 m sec<sup>-1</sup>. Our results indicate that the detailed shape of the profile is not too significant, but that a maximum updraft of about 15 to 20 m sec<sup>-1</sup> favours hail growth.

Regarding the medium on which the hail feeds, we considered super-cooled cloud of adiabatic concentration or less, and combinations of cloud and stored rain. Since, at least in Alberta skies, the abundance of freezing nuclei is apt to insure that most rain is frozen at temperatures -15°C and colder, we believe the cloud/rain combination to be ineffective in promoting hail growth. Hence the following may be a rather likely trajectory for the simple cells: an ice pellet, 0.1 cm in diameter, rises through 3 gm<sup>-3</sup> of supercooled cloud, growing at the same time, till its weight balances the maximum updraft of 20 m sec<sup>-1</sup>, then falls back through it, in the process becoming a 3-cm hailstone. Total elapsed time: about 20 min.

23.

## RADAR AND STEREO CLOUD PHOTO MEASUREMENTS OF AN

### ALBERTA HAILSTORM

A.J. Chisholm and C. Warner

On June 29, 1967 a hailstorm travelled east-southeastward for six hours across the Alberta Hail Studies Project Area yielding hail up to golfball size. This storm was observed by a narrow-beam 10 cm radar at Penhold and by two 16 mm time lapse cameras located on a 3.4 mile base-line. The radar observations reveal a "vault" structure within the storm, which corresponds to a flat non-precipitating cloud base on the 16 mm cloud film. Dense precipitation areas observed by cloud photography are found to agree with areas of high reflectivity on radar and areas of intense hailfall at the surface. A spiral vortex or "mini-tornado" viewed for approximately 6 minutes by cloud photography is correlated with the radar "vault".

24.

#### CLOUD STEREO-PHOTOGRAMMETRY FOR HAIL STUDIES

J. Renick, M. Balshaw and R.H. Douglas

A system of cloud stereo-photography has been in use for several summers in the Alberta hail project, using lapse-time cine-cameras. A novel and relatively rapid technique has been developed for obtaining quantitative cloud-measurements from the stereo-pairs. The method involves the "counter-projection" of the stereo-pair onto a gridded screen, from opposite directions, enabling the unambiguous identification of a common cloud feature such as a cumulus turret. The angle subtended at the cloud is obtained directly, rather than by using two azimuth angles. Data are smoothed, and relevant parameters calculated, by computer. Some aspects of the behaviour of cumulus turrets will illustrate the value of the technique.

25.

#### WIND MEASUREMENTS NEAR ALBERTA HAILSTORMS

N. Thyer

Wind data taken at different levels near a convective storm can be combined to give pictures of the circulation near the storm at those levels. Hence divergence and vertical velocities can be calculated. Some examples are presented for Central Alberta storms of summer, 1967.

26.

#### HARPI: A NEW WEATHER RADAR DISPLAY

I.I. Zawadzki and E. Ballantyne

For HARPI, a weather radar antenna scans routinely in azimuth and (slowly) in elevation, as for CAPRI. The range is divided into uniform intervals of a few miles. For each interval, the maximum signal in the few-mile range interval is displayed against vertical and horizontal coordinates of elevation and azimuth, and so of height and circumferential distance. This gives, for one interval, a strip of much less extent in the vertical. Many such strips are displayed one above the other, for progressively increasing range, in a Height-Azimuth-Range Position Indicator. Display equipment using a cathode-ray tube and Polaroid camera has been built and used through half a hail season at Penhold, Alberta. The potential of the new display is demonstrated by a detailed analysis of the structure of one hailstorm.



27.           PRELIMINARY INVESTIGATION OF SULPHATES AND CHLORIDES  
              IN ALBERTA PRECIPITATION

Peter W. Summers and Brian Hitchon

Agriculturists and soil scientists have noted a decrease in the sulphur deficiency of some Alberta soils in recent years. Losses of sulphur to the atmosphere from sulphur plants and sour gas flaring have increased rapidly since 1960. In addition there has been a marked reduction of severe hail activity over large areas of the province since 1961. In order to ascertain whether these three observations are related, a pilot study was set up to collect and analyse precipitation samples (mostly rain) during the summers of 1966 and 1967. Sulphate concentrations vary from only to 0.04 mg/l in rain collected at Fort Vermillion in northern Alberta, to a maximum of 11 mg/l in a decaying hailstorm SW of Red Deer. The mean value for 52 samples was 2.5 mg/l. For 17 samples an accurate rate of rainfall was recorded, and there is evidence of an inverse relation between rainfall rate and sulphate concentration.

28.           A CHALLENGING EXPERIMENT IN APPLIED METEOROLOGY

D. Storr

The aims, organization and methods of the East Slopes (Alta) Watershed Research Program are described with particular reference to Marmot Creek.

29.           PRECIPITATION PARTICLES AND SMALL-SCALE TURBULENCE

Roland List

Wakes of freely falling water drops were investigated in order to find information about turbulence which might occur in a cloud and have a scale similar to the drop diameter. The results lead to the conclusion that, inspite of considerable wake dimensions (wake length 1340 drop-diameters, average width 5 diameters, for 2.9 mm drops), the eddy intensity is small, and that the fluctuating velocities will not affect the heat and mass exchange and the aerodynamics of other liquid hydrometeors. The chances that particle-induced small scale turbulence leads to particle disruption are expected to be very small.

30.           ICE NUCLEI IN FREE AIR AND IN PRECIPITATION

David Bishop and George Isaac

Simultaneous measurements of the concentration of ice nuclei in the air at the ground, and in precipitation, have been obtained. The former were obtained by an NCAR counter, the latter by a droplet-freezing technique. The data include occasions both of convective and of continuous precipitation. The data obtained by the two techniques will be compared, and discussed with respect to variations with time and with precipitation rate.

31. THE CONCENTRATION AND ORIGIN OF NATURALLY OCCURRING  
ICE NUCLEI AT SASKATOON

R.S. Schemenauer

An investigation of the nature and origin of atmospheric ice nuclei in Saskatchewan, was carried out during the summer of 1966. The ice nucleus concentration was measured each day at 1:30 P.M., and an attempt was made to correlate the variation with various meteorological parameters. A positive correlation was found with relative humidity, and weaker correlations with precipitation, temperature, amount of cloud cover and a number of other parameters. Counts were made at three temperatures, -22, -26, -30°C with the counts at -30°C ranging from 0 - 150 nuclei/litre. A possible explanation for the relation with relative humidity is advanced. Samples of the various Saskatchewan soil types were tested for their ice nucleating ability by two methods, with clays in general being found to be the most efficient nucleators, followed by the topsoils, with the sands being the poorest nucleators. The differences were not sufficient, however, to exclude the possibility that the large dune sand areas in the Province are an important source of atmospheric ice nuclei, since they represent exposed areas where particles may most easily be carried aloft.

32. ARTIFICIAL ICE NUCLEI FOR HAIL MODIFICATION

Gabor Vali

Many different substances have been found over the years which, in the laboratory, effectively promote the formation of ice. The transfer of these laboratory results to atmospheric applications, however, has been greatly hindered by the lack of thorough understanding of the mechanisms that are operating in the laboratory experiments. Recent progress in this direction, as well as the finding that some surface soils are abundant sources of natural nuclei, help to clarify some aspects of the competition between natural and artificial nuclei. Experiments also indicate some natural nuclei may be as small as  $10^{-6}$  cm in diameter, so that capture of these nuclei by cloud droplets can be quite efficient; this too affects the setting of desirata for artificial ice nuclei which would be effective in a hail cloud.

33. SOME SHORT-TERM, LOCAL INFLUENCES OF WIND DIRECTION ON ATMOSPHERIC  
ELECTRICITY AT GROUND LEVEL AT SASKATOON

J.E. Pakiam and J. Maybank

Experimental observations of the potential gradient and the air conductivity at Saskatoon have indicated that wind direction may have a pronounced effect on the night time values of these parameters. Two examples with well enhanced effects are presented and it is suggested that these were due to the influence of man-made charge "generators". A third example of more subtle effects was analysed quantitatively and led to the conclusion that a 270 degree segment is a 360 degree directional circle at the site of observation was affected by local generators.



34.

OBSERVATIONS OF ATMOSPHERIC POTENTIAL  
GRADIENT AT METEOROLOGICAL RESEARCH STATION, TORONTO

Dr. Bhartendu

A radioactive collector, installed at 1 meter above the ground, was used to measure electric field along with meteorological elements such as pressure, temperature, relative humidity and wind speed. Simultaneous recordings were obtained for six months in 1967.

Fairweather electric field shows minimum values during night hours and increases at about 7 a.m. (E.D.T.) and remains maximum till about 7 p.m. (E.D.T.). Spectral density analysis has revealed the presence of diurnal component in electric field and various meteorological elements. Results of cross-power spectra are presented.

35. TOTAL SOLAR RADIATION RECORDED IN MONTREAL AND IN THE COUNTRYSIDE

Dr. C. East

Concurrent and continuous measurements of the total solar radiation falling on a horizontal surface have been recorded in Montreal and in the countryside, 15 miles northwest of the city. The measurements reveal a significant reduction of the solar radiation by the urban atmosphere.

36. THE THEORETICAL DISTRIBUTION OF DAILY CLEAR-SKY INSOLATION  
IN A MOUNTAIN BASIN AND ITS SEASONAL VARIATIONS

H.L. Ferguson, H.F. Cork, R.L. Andersen, S. Mastoris and B. Weisman

This International Hydrologic Decade project forms part of the Meteorological Branch contribution to Alberta's Eastern Slopes Watershed Research Program. Marmot Creek Experimental Basin, located about 55 miles west of Calgary, has a horizontal area of 3.6 square miles and elevations ranging from 5200 to 9200 feet. Small-scale variations in theoretical daily clear-sky insolation over the basin are shown in a series of 20 maps for selected days through the year. The calculated values take account of extra-terrestrial effects, atmospheric attenuation due to microscopic aerosols, and topographical influences. Individual computations of direct-beam insolation were carried out on an hourly basis for a square-grid array of 936 points with longitudinal and latitudinal horizontal spacing of 300 feet. Calculations, performed on an IBM 7044 computer, took account of aspect, elevation, and shadow effects at each grid point. Total basin insolation values obtained from the grid method are compared to values calculated using a best-fit plane or "covering-lid" approach, with a resulting difference of less than 2%. Influences of diffuse solar radiation, absorption by clouds and surface albedo are discussed. The results should prove useful in continuing studies of basin energy budget, local circulations, vegetation, and evapotranspiration.



37. TOPOGRAPHICAL VARIATIONS IN DIRECT SHORT-WAVE RADIATION  
INCOME AT MONT ST. HILAIRE, QUEBEC

B.J. Garnier and Atsumu Ohmura

A formula has been developed whereby variations in the short-wave radiation income on different slopes in any latitude can be easily determined from a knowledge of surface geometry and the sun's declination. This is achieved by expressing slope characteristics and the sun's position as unit vectors in the co-ordinates of a common system, and multiplying the cosine of the angle between the two vectors by a factor involving the solar constant, atmospheric transmissivity and the optical air mass. Integration of the formula permits the topographic variations of direct short-wave radiation income over specified areas to be calculated for daily or longer periods from radiation observations at a single site. The device has been used to map the topographic variations in direct short-wave radiation income at Mont St. Hilaire, Quebec, for days representing conditions at the autumnal equinox and the summer and winter solstices of 1967. These maps will be presented in conjunction with a description of the method used to compile them.

38. BOUNDARY LAYER COUPLING - A BRIEF SUMMARY OF RECENT  
PROGRESS AND PROPOSALS

K.D. Hage

Researches concerned with the interactions and coupling between the free atmosphere and the planetary boundary layer have increased markedly in number and scope with the last few years partly in response to needs for more detailed short-period predictions of weather elements within the boundary layer and partly in response to the requirements of general circulation models and proposed extended-range forecasting studies. Relatively rapid progress seems likely in the improvement of short-period forecasts if suitable observations are made available on appropriate time and space scales. Progress on general circulation models and extended-range forecasting will be hampered until ways and means are found to parameterize boundary layer processes over relatively large areas and to provide for realistic two-way interaction between the free atmosphere and the boundary layer. A brief summary of recent results and proposals relevant to these important problem areas is given.

39. NUMERICAL SOLUTIONS FOR THE FLOW ABOVE A CHANGE IN  
TERRAIN ROUGHNESS

P.A. Taylor

Numerical solutions have been obtained for the partial differential equations governing the flow in the internal boundary layer which develops above a change in surface roughness. The investigation is restricted to cases of neutral thermal stability and the upstream flow is assumed to have a constant shear stress and logarithmic velocity profile. The "mixing length" relation between shear stress and the velocity profile is used throughout and one of the aims of the analysis is to compare the resulting shear stress and velocity profiles with those obtained by Panofsky and Townsend (Quart. J. Roy. Met. Soc. 90 (1964) pp. 147-155) who use an assumed cross-stream distribution for the shear stress and velocity profile.



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40.

AIRBORNE TECHNIQUES IN CLIMATOLOGY AND HYDROLOGY

OASIS EFFECT OVER PRAIRIE TERRAIN

R.M. Holmes

A light, single-engine aircraft instrumented to measure air temperature and radiation temperatures of the earth's surface has been used successfully to identify several prairie oases. Climatic discontinuities produced by an irrigation project and two prairie lakes have been monitored. Air cooled by passage over these oases was measurable and surface radiation temperature differences between dry and moist areas were large. Under the most extreme conditions measured, air cooling of  $3^{\circ}\text{C}$  was noted up to 120 m above Lake Pakowki in South East Alberta and this cooled air often persisted up to 10 km down wind from the lee edge of the lake. Surface temperatures of the surrounding land varied greatly but occasionally were  $28^{\circ}\text{C}$  warmer than the lake surface.

41.

SURFACE WINDS IN RELATION TO SLOPING TERRAIN

H.P. Wilson

Surface airflow near obstacles is discussed by reference to elementary theory.

42.

THE EFFECT OF MINOR RELIEF ON THE DISTRIBUTION OF PRECIPITATION

R.B.B. Dickison

Terrain has long been recognized as a major factor determining the distribution of precipitation. Some investigators have attributed a positive role to rather minor terrain features, ranging in scale down to 10-foot knoll. Others have found no significant relation between rainfall and minor elevation differences, particularly in interior sheltered valleys. Some of the ways in which minor topographical features may operate to influence precipitation distribution are discussed: physical barrier effect, surface roughness, differential heating, standing wave amplification, local wind distribution. The results of a field project in New Brunswick are presented, showing no significant difference between ridge and valley rainfall along a minor feature oriented at right angles to the prevailing wind flow.



43.

#### FREEZING PRECIPITATION AND ICE ACCRETION

G.A. McKay and H.A. Thompson

Ice accretion on wires and supporting towers is a problem of major economic importance. The basic cause is freezing precipitation, but there has been no serious attempt to relate this parameter to the amounts of accretion which occur. The frequency of occurrence of freezing precipitation provides an index of the hazard, but this is inadequate for the design engineer. The statistics of freezing precipitation rates and amounts are investigated. Coincident observations of accretion and freezing precipitation amounts are difficult to obtain, but essential to the solution of this problem.

44.

#### THE CLIMATE OF THE CYPRESS HILLS: DESCRIPTION OF THE SITE AND PROBLEM

R.M. Holmes

A unique area of Hills rises approximately 2,000 feet out of the prairie of south-east Alberta and south-west Saskatchewan. The heavily forested northern edge slopes steeply to the flat and almost treeless summit on the Alberta portion which comprises almost 200 sq. miles. The Saskatchewan part, while lower in relief, covers more area and has scattered forests on the slopes and summit. The entire unit is an ecological-biological-hydrological-climatological oddity compared to the surrounding prairie and presents an ideal situation to study the effects of terrain on climate, biota, and land form formation. This paper describes the area and outlines the climatic studies now in progress. Data will be used to relate quantitatively the climate and hydrology of the Cypress Hills to the nature of the terrain and also to relate climate of the Hills to the surrounding prairie.

45.

#### DIFFUSION AND DEPOSITION OF SMALL PARTICLES FROM AN ELEVATED INSTANTANEOUS POINT SOURCE

O. Johnson

A number of trials have been carried out involving instantaneous point source emission of 50-and 100-micron glass spheres from a height of 88 metres and measurements of the resulting deposition pattern on the ground. The observed crosswind-integrated deposit density is a function of downwind distance and the crosswind spread of the particles are compared with those predicted by theoretical models.

46. DIFFUSION OF PARTICULATES FROM AN ELEVATED POINT SOURCE

J.A. McCallum

Fourteen trials have been completed in which small particles were emitted continuously for a period of about 30 minutes, from an elevated point source. The resulting ground deposit patterns are shown, and their dependence on atmospheric stability, wind speed, and particle size. The observed patterns are compared with predictions of the Pasquill and sloping plume models, and also with a simulated model.

47. THE INTERACTION BETWEEN DAYTIME URBAN AND LAKE MESOSCALE CIRCULATIONS AT TORONTO

R.E. Munn, M. Hirt and B.F. Findlay

Metropolitan Toronto (population of about 2,160,000 and area of 2282 km<sup>2</sup>) is on the north shore of Lake Ontario (area of 90, 150 km<sup>2</sup>). The interactions between the daytime urban heat island and the lake-circulations are studied using several years of records of daily maximum temperature from a network of about 16 observing stations, and prestratifying the data according to the regional wind patterns at the geostrophic level and according to the daily sunshine total.

A significant result is the displacement of the urban heat island in response to lake-breeze wind patterns.

48. DIFFUSION IN AN EKMAN LAYER

G.T. Csanady

When a relatively large diffusing cloud is transported by the flow in an Ekman layer, the trajectory and the rate of spread of the cloud are affected by the velocity variations both along and across the geostrophic wind. In a first approximation, these effects may be calculated with the aid of the classical diffusion equation using constant eddy-diffusivity and the classical Ekman layer velocity-profile, also derived on the basis of a constant eddy-viscosity.

Analytical solutions (obtained by the "concentration-moment method") show that the ground level trajectory of an instantaneously released cloud departs significantly from the surface wind track at distances from the source beyond a few kilometres, and that this track remains in the sector between surface and geostrophic winds, but it does not follow asymptotically either wind direction. The spread of the cloud, as observed at ground level, is dominated beyond the first few kilometres of travel by the "wind-shear effect" on diffusion, the mean square dispersion increasing rather more rapidly than it would due to atmospheric turbulence alone. Asymptotically (and this means at very large distances, in practice on global scale) the mean square dispersion at ground level becomes proportional to an "effective" shear-diffusivity several orders of magnitude greater than the eddy diffusivity.



CANADIAN METEOROLOGICAL SOCIETY

2nd Annual General Meeting, 7:30 p.m., Monday June 3, 1968

University of Calgary, Calgary, Alberta.

A G E N D A

The President in the Chair.

1. Presentation of the Patterson Medal.
2. Minutes of the 1st Annual General Meeting; Canadian Meteorological Society, Carleton University, Ottawa, Ontario, 25 May 1967.
3. Reports of the Executive Committee.
  - a) Annual Report of the C.M.S.
  - b) Treasurer's Report
  - c) Nominating Committee Report
  - d) Editor's Report - . . .
  - e) Prize Committee Report -  
- presentation of the C.M.S. Prizes
    - i. President's Prize
    - ii. Prize in Applied Meteorology
    - iii. Undergraduate Student Prize
    - iv. Graduate Student Prize.
  - f) Report on the Society's participation in the Canadian Science Fair.
4. Reports from the Local Centres.
5. Budget for period 1 Jan. 69 - 31 Dec. 69.
6. Publication policy for the Society.
7. Amendment to the Society's By-Laws.
8. Other Items.
9. Installation of new officers.

Minutes of the First Annual Meeting of the Canadian Meteorological Society held at Carleton University, Ottawa, Ontario, May 25, 1967, in the Alumni Theatre of Southam Hall at 1:00 p.m.

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1. MINUTES OF THE 26TH ANNUAL GENERAL MEETING OF THE CANADIAN BRANCH OF THE ROYAL METEOROLOGICAL SOCIETY HELD JUNE 9, 1966 AT SHERBROOKE UNIVERSITY, P.Q.

Mr. J.R.H. Noble moved that the minutes of the 26th Annual General Meeting be approved as published. Seconded by Dr. A. Thomson. Carried.

2. ANNUAL REPORT OF THE CANADIAN BRANCH OF THE ROYAL METEOROLOGICAL SOCIETY, EXECUTIVE COMMITTEE

Moved by Mr. Cameron and seconded by Dr. S. Orvig that the printed report be adopted. Motion Carried.

Treasurer's Report

The Treasurer reported that there was a small deficit due to depreciation of stocks held by the Society and due to the fact that the Society had paid the travelling expenses for Mr. Robinson's visit. He noted that there were 22 unpaid members at the end of 1966 of which 15 were still outstanding. At the time of the meeting 243 members had paid membership to the Canadian Society while 390 individuals had indicated their intentions of becoming members.

Mr. Gee moved that the audited treasurer's report be accepted. Seconded by C.M. Penner. Motion Carried.

Auditor

Mr. Gee reported that Mr. R.D. Easto had audited the books for 1966. Moved by Mr. G. Pincock that we acknowledge Mr. R.D. Easto's assistance with an honorarium of \$30.00. Seconded by Dr. Maybank. Motion carried.

1968 Fees

The Treasurer moved that the 1968 fees for members and students be maintained as they are. Seconded by Dr. Munn. Motion Carried.

It was agreed that discussion of Corporate Memberships be deferred until later in the meeting.

Nominating Committee Report

The Committee consisting of Dr. W.L. Godson, Dr. B. Boville and Dr. R.E. Munn nominated the following for office during 1967-68.



President	- A.W. Brewer
Vice President	- M.K. Thomas
Treasurer	- G. Gee
Corresponding Secretary	- H. Cameron
Recording Secretary	- D. Bauer
Past President (ad hoc basis)	- R.E. Munn
Councillors at Large	- P. Summers - J. Gregory - O. Villeneuve
Editor Atmosphere	- J.A. McCulloch
Auditor	- R.D. Easto

The Recording Secretary, Mr. D. Bauer, informed the meeting that due to an impending transfer he wished to withdraw his name. Moved by Dr. Boville and seconded by Dr. Longley that the remaining nominees be declared elected. Carried.

Nominations were then invited from the floor for the position of Recording Secretary. Mr. G. Pincock nominated Mr. L. Shenfeld. Seconded by Dr. J. Clodman. Since there were no further nominations, Mr. L. Shenfeld was declared elected.

#### Membership Committee Report

In the absence of Mr. F.D. Thompson, Chairman of the Membership Committee, the Corresponding Secretary presented the report.

It was reported that total membership in the CMS as of May 1, 1967 was 395, of these 63 full members and 12 student members had been elected since January 1, 1967.

After some discussion on the procedure of advising applicants of receipt of application and of election, it was moved by Dr. J. Clodman and seconded by Dr. Ashwell that the report of the Chairman of the Membership Committee be accepted. Carried.

#### Editor's Report

In the absence of the Editor, Dr. Munn presented the Editor's report. He reported on the change in format in the last issue of Atmosphere. The cover was redesigned by L.G. Tibbles and advertising was included. He noted that advertising contracts had been let for the current year which would very nearly cover the current cost of approximately \$325 per issue. Members were requested to submit papers and letters to the editor and to notify the editor of potential advertisers.

After considerable discussion re publication policy, the form Atmosphere should take, the cost of publishing a scientific journal, etc., it was moved by Dr. J. Clodman "That the executive prepare a publication policy during the coming year and present it at the next Annual General Meeting". Seconded by Dr. Hay. Motion carried.

Dr. Munn moved that the editors report be accepted. Seconded by G.W. Robertson. Motion carried.

#### Reports from Local Centres

Mr. Tissot Van Patot proposed that the printed reports from the centres be accepted. Seconded by Mr. Ashwell. Motion Carried.

#### Amendments to CMS Bylaws

Proposed amendments to the CMS bylaws and appendix thereto were discussed by Mr. M.K. Thomas. Mr. Thomas moved that the proposed amendments be approved. Seconded by Mr. S.J. Buckler. Motion Carried.

Moved by Prof. Boville and seconded by Dr. Maybank that in the appendix section (b) "Prize in Applied Meteorology" all after the first sentence be deleted (i.e. section (b) to read "Prize in Applied Meteorology: A prize in Applied Meteorology may be awarded each year to a Member of the Society for an outstanding contribution in the field of Applied Meteorology"). Motion Carried.

### 3. NEW BUSINESS

#### National Science Fair - Youth Science Council

Mr. G.W. Robertson moved that the executive consider some form of an award for the best exhibit at the National Science Fair, dealing with Meteorology or related fields. Seconded by Dr. Hitschfeld. Motion Carried.

#### Corporate Membership Fees

Moved by Mr. M.K. Thomas and seconded by Prof. Boville that corporate membership fees be set at \$25.00.

Moved by Mr. Tissot Van Patot that the motion be amended to read " ..... fees be set at a minimum of \$25.00 per annum." Seconded by Prof. Orvig. Amendment Carried.

The original motion as amended was approved.

#### 2nd Annual Congress - 1968

Mr. Ashwell moved that the Society consider holding its 1968 meeting at the University of Calgary from June 3rd to 5th inclusive. Seconded by Mr. H. Cameron. Motion Carried.



Annual Dinner

Moved by Dr. Davies and seconded by Father East that the annual dinner not include a religious ceremony. Motion Carried.

There being no further business the new officers were installed and the meeting was adjourned at 3:30 p.m.

Following the Annual General Meeting members departed by bus for a tour of the Gatineau and a dinner at the Edelwies Ski Lodge.

After the dinner the Canadian Meteorological Society prizes for 1966 were awarded.

Dr. M.B. Danard was awarded the President's Prize for three papers:

"On the Contribution of Released Latent Heat to Changes in Available Potential Energy.  
J. Appl. Met. 5, 81-84."

"A Quasi-Geostrophic Numerical Model Incorporating Effects of Release of Latent Heat.  
J. Appl. Met. 5, 85-93."

"Further Studies with a Quasi-Geostrophic Numerical Model Incorporating Effects of Released Latent Heat.  
J. Appl. Met. 5, 388-395."

The Prize in Applied Meteorology was awarded to G.W. Robertson for his contribution to the paper "A New Versatile Soil Moisture Budget", Canadian Journal of Plant Science, 46, 299-315.

D.J. Bauer,  
Recording Secretary.

ANNUAL REPORT

OF

THE CANADIAN METEOROLOGICAL SOCIETY

1967 was a very progressive year for the Society. The long active association of many of its members with the Canadian Branch - Royal Meteorological Society no doubt assisted the newly formed society to make the first year such a success. However, the year was not without its problems. Growing pains are normal with most developing societies and the CMS with a membership of over 500 certainly had its share. However, since the majority of these problems were associated with an increasing workload at the National Headquarters level, and since many of them are now under control, it is envisaged that next year's operation should be a much smoother one.

Membership

The growth of the society continues. On January 1, 1967, following receipt of the completed questionnaire, 270 had signified their intention to be members. By May 1967, the membership had increased to 395 and today the total membership is: general 453 student 58 corporation nil.

Local Centres

The Local Centres have grown in membership but remained constant in number - Halifax, Montreal, Ottawa, Toronto, Winnipeg, Alberta and Vancouver. Negotiations are currently underway for the establishment of a Local Centre with its headquarters at Quebec, P.Q.

First Annual Congress of the C.M.S.

The first Annual Congress of the Society was held at Carleton University, Ottawa May 24-26, 1967. Under the management of the Program Committee Chairman, Dr. J. Glodman, a most excellent program was developed in which 5 Survey Papers and 28 papers on specific subjects were presented.

The Program was arranged in five sessions: -

Session 1 - Cloud and Precipitation Physics - Chairman,  
Prof. R. List, University of Toronto.

Session 2 - Dynamic Meteorology - Chairman, Dr. Andre Robert,  
Meteorological Branch, Montreal.



- Session 3 - Applied Meteorology and Climatology - Chairman,  
Mr. C.M. Penner, Meteorological Branch, Toronto.
- Session 4A - The Upper Atmosphere - Chairman, Dr. A.D. Christie,  
Meteorological Branch, Toronto.
- 4B - Winds and Turbulence, Chairman, Prof. D. Hay,  
University of Western Ontario, London, Ont.
- Session 5 - Meteorology and the Future - Chairman, Prof.  
A.W. Brewer, University of Toronto.

Approximately 116 members registered for the Congress. The Local Co-ordinator Mr. Micheal Webb, Ottawa did an excellent job in looking after all physical arrangements for the Congress.

#### First Annual General Meeting

On May 25, the First Annual Meeting of the Society was held in conjunction with the Congress. The meeting was well attended and through constructive criticism and lively discussion gave good direction to the incoming Council on such matters as: the need for a Publication Policy for the Society; the reprinting of an amended version of the Constitution and By-Laws document; clarification on the Society's Prizes and Awards; the participation of the Society in the National Science Fair by providing an award to the best exhibit dealing with meteorology or a related field; and, the setting of the Corporation membership fee to be at a minimum of \$25.00 per annum.

The Council and national Executive for the coming year were approved as follows:

President - A.W. Brewer

Vice President - M.K. Thomas

Editor Atmosphere -  
J.A. McCulloch

Treasurer - G. Gee

Auditor - R.D. Easto

Corresponding - H. Cameron  
Secretary

Recording - L. Shenfeld  
Secretary

Past President- R.E. Munn

Councillors at  
Large

- P. Summers
- J. Gregory
- O. Villeneuve

### Annual Dinner

The Annual Dinner, under the able management of Mr. M. Webb, Ottawa, was held at the Edelwies Ski Lodge in the Gatineau Mountains of Quebec. During the evening, the Society prizes for 1966 were presented by the President, Prof. A.W. Brewer: -

President's Prize - Dr. M.B. Danard

Prize in Applied Meteorology - Mr. G.W. Robertson

The Director of the Meteorological Branch, Mr. J.R.H. Noble, presented the Patterson Medal for 1966 to Mr. C.C. Boughner, Chief, Climatology Division, Meteorological Branch, Toronto.

The Society, in keeping with its aims is broadening its interest in meteorology within Canada. It will be a co-sponsor with the American Meteorological Society at the forthcoming 13th Radar Meteorological Conference which is to be held at McGill University, Montreal, 20-23 August 1968. The Society hosted for an evening the U.S. Atomic Energy Commission Micro-meteorological meeting held at Chalk River, Ontario, at which more than 100 meteorologists, mainly from the U.S. attended. In addition the Society is a co-sponsor of a Work Shop on GARP (Global Atmospheric Research Program) which is to be held in Calgary following the Second Annual Congress of the C.M.S. Further to the above, the Vice-President has been active in developing a national program whereby selected specialists, through the efforts of the Society, will give presentations on special topics at the Local Centres during the coming year.



STATEMENT OF RECEIPTS AND EXPENDITURES FOR  
THE YEAR ENDED DECEMBER 31, 1967.

RECEIPTS:

1966 R.M.S. fees	\$ 106.00	
1967 C.M.S. fees	1939.00	
1968 C.M.S. fees	<u>885.00</u>	\$2,930.00

OTHER INCOME:

Bond Interest	51.00	
Bank Interest	12.01	
Dividends - Bell Telephone	30.00	
Profit - 1967 Annual Conference	89.90	
Refund - Met. HQ re printing Dr. Munn paper	60.00	
Subscriptions to Atmosphere	<u>18.00</u>	260.91
TOTAL RECEIPTS		<u>\$3,190.91</u>

EXPENDITURES

Fees to R.M.S.	\$ 76.45	
Bank Charges and exchange	15.50	
Postage	141.15	
Grants to Centres	76.95	
Stationery	54.49	
Atmosphere: Printing, Typing, Postage, Plates, etc.	904.03	
Refund of fees - overpaid	161.70	
Atomic Energy Conference	12.70	
Honorarium to Auditor	100.00	
	<u>30.00</u>	\$1,572.97

Bank Balance - Jan. 1, 1967	\$ 776.51	
Plus receipts 1967	3190.91	
Less expenditures 1967	<u>1572.97</u>	\$2,394.45

Less Bell Telephone Dividend not deposited until Jan. 3/68		<u>7.44</u>
		\$2,387.01

Balance - Bank of Montreal Acct. #100 Dec. 31, 1967	\$ 571.92	
- Canadian Imperial Bank of Commerce - Acct. #80-02614	<u>1815.09</u>	\$2,387.01

BALANCE SHEET AS OF DECEMBER 31, 1967

ASSETS

Bank Balance as of December 31, 1967		\$2387.01	
Bonds    Market Value December 31, 1967			
\$1000. Gov't of Canada 3 $\frac{3}{4}$ % 1978		790.00	
300. Gov't of Canada 4 $\frac{1}{2}$ % 1983		240.00	
Bell Telephone - Market Value Dec. 31, 1967			
12 shares at \$44.88		<u>538.50</u>	\$3955.51

LIABILITIES

1968 C.M.S. fees paid in advance		885.00	
Surplus 31 Dec. 1966	\$2112.01		
Surplus for year 1967	<u>958.50</u>	<u>3070.51</u>	\$3955.51

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 Branch's financial position as at December 31, 1967.

R.D. Easto.



1967 ANNUAL REPORT - ATMOSPHERE

The editorial committee has experience difficulties in several areas during the last year. Initially, when the responsibility for publishing was transferred from Montreal to Toronto, the choice of a suitable printing company was the prime concern of the committee, and after many tenders and quotations, it was felt that a fitting printer had been found. Unfortunately, it was immediately apparent that the choice was questionable. Considerable delays were encountered and difficulties arose with the advertising due to union and associated affiliations. However, the majority of the difficulties have now been surmounted and it is fully expected that future issues of Atmosphere will be published at the appropriate times.

While sufficient papers have been received to plan at least two editions simultaneously, the greatest problem has been to obtain current news and small interesting contributions from Centres and universities. Members are reminded that such contributions are most welcome, as are advertisements from local businesses, either publishers, manufacturers or professionals. Rates are available on application to editor.

E.J. Axton

Proposed Budget for period 1 Jan. 69 -  
31 Dec. 69

1. Background

1.1. Atmosphere

The major expenditure of the Society is expected to be the preparation and publication of ATMOSPHERE. Funds are required to cover the costs of 4 issues per year. It is hoped to recover part of this cost through advertising, but since no binding negotiations have been made as yet, funds from advertising are not shown in the proposed budget.

1.2. Grants to Local Centres

Under the constitution any Local Centre can claim up to \$20 from the National Executive to defray specific expenses for a Local Centre meeting. To provide each Centre with more flexibility in the operation of its local programs, it is suggested that each Centre be provided with \$75. This amount will be accounted for by the local Executive at the end of each fiscal year.

1.3. Annual Meeting and Congress

It has been estimated that the cost of typing, printing, mailing, etc. of material for the scientific meeting and the business meeting at the Annual Congress be approximately \$670.

1.4. Awards and Prizes

The Society is currently responsible for providing at least four prizes.

- President's Prize
- Prize in Applied Meteorology
- Undergraduate student
- Youth Science Foundation - Science Fair Award

A sum of \$100 is a reasonable amount to cover the costs of the prizes.

1.5. Auditor Honorarium

\$30 appears to be reasonable for the services of an Auditor.

1.6. National Executive Operating Expenses

The estimated costs of stationery for the National and Local Executives, bank charges, postage, typing and mailing services are approximately \$455.

1.7. Grant from the Meteorological Branch

The Society plans to submit a formal request to the Met. Branch for a grant of \$1,000. in 1969-70 to assist in the development of the Society across Canada.

1.8. Total Membership

The total paid up membership in 1969 is forecasted to be 500 general members and 100 students.

1.9. Membership Fees

It is recommended that the current fees of \$6 for general membership and \$1 for student membership be increased on 1 Jan. 69, to \$7 for general membership and \$3 for student membership.



2. Proposed 1969 Budget

Expected Receipts

<u>Dividends and Interest</u>		80.00
<u>Annual Fees</u>	500@ \$7.00	\$3,500.00
	100@ \$3.00	300.00
		<u>\$3,800.00</u>
<u>Meteorological Branch Grant</u>		\$3,800.00
		1,000.00
		<u>\$4,880.00</u>

Proposed Expenditures

Atmosphere

Typing and preparation	4 @ \$50.	\$ 200.00	
Mailing	4 @ \$25.	100.00	
Printing	4 @ \$700.	2,800.00	
		<u>\$3,100.00</u>	\$3,100.00

Annual Meeting and Congress

Typing and preparation	50.00	
Mailing	20.00	
Printing	600.00	
	<u>\$ 670.00</u>	\$ 670.00

Awards and Prizes

\$ 100.00

Auditor Honorarium

\$ 30.00

Grants to Local Centres 7 @ \$75.

\$ 525.00

Executive Operating Expenses

Postage	\$305.00
Stationery	125.00
Bank Charges	25.00
	<u>\$455.00</u>

\$ 455.00

\$4,880.00

Publication Policy for the CMS

1. ATMOSPHERE is an official publication of the Society. No other publication is envisaged at present.
2. ATMOSPHERE will contain articles of general meteorological interest, review and survey papers, scientific and technical papers, and announcements and news of interest to the members of the Canadian Meteorological Society, and will be published quarterly.
3. The Editorial board will attempt to provide something of interest to all members, non-specialist as well as specialist.
4. Research papers in specialized subjects will be welcomed. It is hoped that enough of those will be submitted so that each issue will contain at least one such paper.
5. The Editor-in-chief will decide on acceptance or rejection of any manuscript. Appeals by any member against rejection of a manuscript may be made directly to Council. Reviewers will not only consider the scientific content, but will attempt to promote readability, clarity and ease of understanding.
6. A copy of the final typed manuscript will be sent to the author for final proofreading prior to printing. Authors typographical corrections will be allowed, but changes in phraseology or other major changes will not be accepted.
7. Authors will be given fifty reprints free-of-charge. A schedule of charges for additional reprints has been established. Rates of charge are subject to change in light of experience.
8. Atmosphere will be distributed on the last day of each calendar quarter. Deadlines for receipt of announcements, news items, reports of meeting of Local Centres, etc. will be one month earlier.

Instructions to Authors

1. Manuscripts will be submitted in duplicate, typed double-spaced on  $8\frac{1}{2}$  x 11" bond, with the pages numbered consecutively.
2. Two copies of figures shall be submitted with the manuscript. The originals should be retained by the author until it is established whether or not revisions will be required. A list of the legends for figures shall be typed together on a separate sheet.
3. Authors shall keep in mind when labelling that figures will require reduction to 5" x 8" (full page) or smaller. Photographs shall be glossy prints with good contrast. Other diagrams shall be drawn with pen and ink and be in final form for photographing.



4. Literature citations in the text shall be by author and date. The list of references should be primarily alphabetical by author, and secondly chronological for each author.
5. Units should be abbreviated only if they are accompanied by numerals, e.g. 10 km. but several kilometers.
6. Tables shall be prepared on separate pages each with an explanatory title. Only essential vertical and horizontal ruling will be included.
7. Metric units are preferred.
8. Footnotes to the text should be avoided.

Schedule of Charges for Reprints

The first 500 pages cost:	4 cents per page -	\$20.
The next 500 pages cost:	3 cents per page -	15.
The next 500 pages cost:	2 cents per page -	10.
All additional pages cost:	1 cent each	
Cover pages cost:	3 cents each	

(Orders must be in units of fifty).

Example:

A seven-page article for which 250 additional reprints are required - total 1750 pages: -

Cost - \$20. (first 500 pages)  
15. (next 500 pages)  
10. (next 500 pages)  
2.50 (additional)  
7.50 (cover pages)

55.00 TOTAL

Proposed Amendments to the Constitution and By-Laws of the Canadian Meteorological Society

1. To amend By-Law 4, paragraph (c) to read:
  - c) On or before March 1st the Corresponding Secretary shall send to each member of the Society
    - (i) a list of the members of the current Council
    - (ii) a list of the nominations made by Council or the Nominating Committee, and
    - (iii) a copy of By-Law 4(d)

Cash Accounts Year ending December 31, 1967

Receipts

<u>Fees</u>	1966 R.M.S.	106.00	
	1967 C.M.S.	1939.00	
	1968 C.M.S.	<u>885.00</u>	2930.00 ✓

Other Income

Bank and Bond interest, Bell T. stock div.	85.57	
Subscriptions to "Atmosphere"	18.00	
Net Proceeds 1967 Annual Congress C.M.S.	89.90	
Refund Met. Headquarters for printing R.E. Munn Paper	60.00	253.47
		<u>3183.47</u>

Expenditures

Exchange on cheques	10.31	
Postage	141.15	
Bank Charges	5.19	
1966 R.M.S. fees to U.K.	76.45	
Stationary and Receipt Book	54.49	
Refunds for overpayment of dues	12.70	
Honorarium to auditor	30.00	
Hosting atomic Energy Com. Conf. Sept. 12, 1967	100.00	
Centres	76.95	
Atmosphere Printing	904.03	
Stationary - typing - addressography plates, postage, etc.	<u>161.70</u>	1572.97 ✓

Bank Balance Jan. 1, 1967	776.51	
Plus receipts	3183.47	
Less expenditures	1572.97	<u>2387.01</u>

Bank of Montreal Dec. 31, 1967	571.92	
Bank of Commerce Dec. 31, 1967	1815.09	<u>2387.01</u>



Balance Sheet as of December 31, 1967

Assets

Bank Balance December 31, 1967	2387.01	
Bonds Market Value December 31, 1967		
1000 Gov. of Canada 3 3/4% 1978	790.00	
300 Gov. of Canada 4 1/2% 1983	240.00	
Bell Telephone Common Stock December 31, 1967		
12 shares at 44.88	538.50	<u>3955.51</u>

Liabilities

1968 fees in advance	885.00	
1967 fees in arrears		
74 general members at \$6.00	444.00	
2 student members at \$1.00	2.00	
Printing costs "Summer Atmosphere"	570.98	<u>1901.98</u>
Surplus December 31, 1966	2112.01	
Deficit for year 1967	58.48	<u>2053.53</u>
		<u>3955.51</u>

Net assets or surplus year ending December 31, 1966	<u><u>2053.53</u></u>
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## SECOND ANNUAL CONGRESS

THE SECOND ANNUAL CONGRESS OF THE SOCIETY WAS HELD JUNE 3-5, 1968, AT THE UNIVERSITY OF CALGARY. AGAIN THIS YEAR, THE MEETINGS WERE HELD IN CONJUNCTION WITH THE CONFERENCE OF LEARNED SOCIETIES.

THE CAMPUS OF THE UNIVERSITY OF CALGARY IS QUITE IMPRESSIVE. THE BUILDINGS ARE NEW AND MODERN, AND ARE WELL SEPARATED, PRESUMABLY FOR FUTURE EXPANSION. REGISTRATION AND MEAL SERVICE WAS AT THE STUDENT UNION BUILDING, MCEWAN HALL. THE SCIENTIFIC SESSIONS AND THE ANNUAL GENERAL MEETING WERE HELD IN THE ENGINEERING BUILDING. FURTHER MEAL SERVICE WAS AVAILABLE AT THE DINING CENTRE THAT SERVED THE TWO RESIDENCES. AS A GENERAL RULE, COUPLES WERE BILLETED IN THE WOMEN'S RESIDENCE AND "STAGS" IN THE MEN'S. THE OVERFLOW FROM THE RESIDENCES WAS ACCOMMODATED AT MOTEL VILLAGE (14 MOTELS JUST ONE-HALF MILE FROM THE CAMPUS), AND AT THE DOWNTOWN HOTELS.

### FIELD TRIPS

THERE WERE TWO FIELD TRIPS OFFERED TO PARTICIPANTS. ON TUESDAY AFTERNOON, TWO CHARTERED BUSES AND SEVERAL PRIVATE CARS TOOK VISITORS TO THE MARMOT CREEK WATERSHED PROJECT, A CO-OPERATIVE VENTURE INVOLVING HYDROLOGY, AGRICULTURE, METEOROLOGY AND SEVERAL OTHER SCIENTIFIC DISCIPLINES. THE VISITORS WERE CONDUCTED THROUGH AREAS WHERE GROUND WATER, STREAMFLOW, EVAPORATION, SOIL MOISTURE, AND VARIOUS METEOROLOGICAL PARAMETERS WERE BEING MEASURED. A SUMMARY OF A PAPER (DESCRIBING THE PROJECT), GIVEN BY MR. DON STORR AT THE CONGRESS, WILL BE PUBLISHED IN A FORTHCOMING ISSUE OF ATMOSPHERE.

FROM MARMOT CREEK, ALL ROADS LED TO THE <sup>6</sup> RANCH (RAFTER 6 FOR YOU DUDES) FOR THE ANNUAL BANQUET. BARBECUED STEAKS, A HEATED SWIMMING POOL (BUT OH - THAT WET-BULB COOLING), HORSEBACK RIDES AND A SING-SONG, ALL CONTRIBUTED TO A FINE TIME FOR ALL. THE VISITING TROUBADOUR COMPOSED THE FOLLOWING POEM<sup>\*</sup> IN HONOUR OF THE OCCASION. IT IS BASED ON THE TRIBULATIONS OF METEOROLOGISTS ESPECIALLY DON STORR, AS RELATED BY PROF. CHAMBERS AND MISS BRINKMAN, TWO OF THE LOCAL ARRANGEMENTS COMMITTEE. IT IS SUNG TO THE TUNE OF "LILLI MARLENE", AND SOUNDS MUCH BETTER SUNG THAN READ.

ANOTHER FIELD TRIP TOOK PLACE ON THURSDAY WHEN THE ALBERTA HAIL STUDIES PROJECT AT PENHOLD WAS VISITED. TRANSPORTATION WAS AGAIN BY CHARTERED BUS. THE STAFF AT THE PROJECT HAD ORGANIZED SEVERAL DISPLAYS OF EQUIPMENT, AND EVEN ARRANGED THE FIRST HAILSTORM OF THE SEASON. IT WAS ACCOMPANIED BY WHAT APPEARED TO BE A FUNNEL CLOUD, MUCH TO THE DELIGHT OF THE VISITORS WHO SAW IT. HOWEVER, WHEN REQUESTED FOR AN ENCORE, THEY COULD NOT EVEN COME UP WITH A SMALL VOLCANIC ERUPTION. IN ANY EVENT, THE HOSPITALITY OF THE PROJECT STAFF AND THE CANADIAN FORCES OFFICERS' MESS WAS MUCH APPRECIATED.

\* SEE PAGE 22



## SCIENTIFIC SESSIONS

THE SCIENTIFIC PROGRAM OCCUPIED FIVE HALF DAYS, AS OUTLINED IN THE PROGRAM AND ABSTRACTS BOOKLET THAT WAS MAILED OUT TO ALL MEMBERS BEFORE THE MEETINGS.

ON MONDAY MORNING, PROF. A.W. BREWER, PRESIDENT OF THE SOCIETY, DECLARED THE SECOND ANNUAL CONGRESS OPEN. A WELCOME TO THE CAMPUS BY PROF. I.Y. ASHWELL OF THE DEPARTMENT OF GEOGRAPHY WAS FOLLOWED BY ANNOUNCEMENTS BY THE CHAIRMAN OF THE LOCAL ARRANGEMENTS COMMITTEE, PROF. CHAMBERS. THE LOCAL COMMITTEE UNDER MRS. CHAMBERS HAD DONE A TERRIFIC JOB FOR THE OFFICIAL HOSTS, THE ALBERTA CENTRE OF THE C.M.S.

THE SYMPOSIUM ON THE UPPER ATMOSPHERE WAS CHAIRED BY PROF. JOHN GREGORY, UNIVERSITY OF SASKATCHEWAN. THE KEYNOTE PAPER BY PROF. COLIN HINES (UNIVERSITY OF TORONTO), DISCUSSED THE ADVANCES IN THE DYNAMICS OF THE UPPER ATMOSPHERE THAT HAD BEEN MADE SINCE HE SPOKE ON THE SUBJECT TO THE CANADIAN BRANCH OF THE R.M.S. SIX YEARS AGO.

IN THE INTERVAL BETWEEN THESE TWO PAPERS, MANY MORE OBSERVATIONS OF THE CIRCULATION IN THE MAGNETOSPHERE (THE REGION FROM 150 KM OUT TO THE BOUNDARY OF THE GEOMAGNETIC DOMAIN - 10 EARTH RADII ON THE SUN SIDE AND SOME INDEFINITE DISTANCE ON THE OTHER SIDE), HAVE BEEN MADE. THESE OBSERVATIONS CONFIRM THE ESSENTIALS OF THE HINES-AXFORD MODEL OF MAGNETOSPHERIC CIRCULATIONS, WHILE CHANGING ONLY THE DETAILS. IN PARTICULAR, DENSITY CHANGES BY A FACTOR OF 100 OVER A FEW KILOMETERS, RESULTING FROM CIRCULATIONS, HAVE BEEN OBSERVED. PROF. HINES POINTED OUT THAT THE STRONG WEST WINDS THAT ARE OBSERVED IN THE IONOSPHERE AT 200 TO 300 KM ARE GENERATED METEOROLOGICALLY, BUT THERE ARE STRONG INFLUENCES OF ION DRAG (ESPECIALLY ON TIME SCALES OF LESS THAN ONE HOUR), EVEN THOUGH THE DENSITY OF IONS IS STILL SMALL RELATIVE TO THE DENSITY OF THE NEUTRAL GAS. HE STATED FURTHER THAT ON THE DIURNAL SCALE, NON-LINEAR COUPLING BETWEEN CHANGES IN ION CONCENTRATION AND CHANGES IN PRESSURE (OR DENSITY) MUST MAKE A SIGNIFICANT CONTRIBUTION TO THE WEST WINDS OBSERVED.

DURING THE REMAINDER OF HIS PAPER, PROF. HINES TOUCHED ON SEVERAL SUBJECTS CLOSER TO THE SURFACE. FOR EXAMPLE, HE DISCUSSED TIDAL EFFECTS IN THE REGION OF 100 KM AS OBSERVED BY SODIUM VAPOUR AND TMA TRAILS FROM ROCKETS, AND COMMENTED ON THE DETAIL IN THE WINDS SHOWN BY THE NEW FRENCH METEOR TRAIL RADAR. HE SHOWED THE POSSIBLE CONNECTION BETWEEN UPSTREAM TROPOSPHERIC JET STREAMS AND NOCTILUCENT CLOUDS, AND COMMENTED THAT WORK ON STRATOSPHERIC-IONOSPHERIC COUPLING WAS INCREASING IN TEMPO, LEADING TO MORE KNOWLEDGE ON THE EFFECTS IN THE HIGH ATMOSPHERE OF EVENTS LOWER DOWN.

THERE FOLLOWED TWO PAPERS ON OPTICAL TECHNIQUES FOR DETERMINING UPPER ATMOSPHERE COMPOSITION (LLEWELLYN AND JONES, AND RUNDLE AND GAULT), AND THREE ON RADIO TECHNIQUES (REES, GREGORY, AND MANSON). THESE FIVE PAPERS WERE ALL CONTRIBUTIONS FROM THE INSTITUTE OF SPACE AND ATMOSPHERIC STUDIES, UNIVERSITY OF SASKATCHEWAN. A.D. CHRISTIE FOLLOWED WITH A DISCUSSION OF NOCTILUCENT

CLOUDS, AND THE SYMPOSIUM WAS COMPLETED WITH TWO PAPERS ON ROCKET RANGE OPERATIONS IN CANADA (WETTER AND HOOPES FROM CHURCHILL, AND FRYERS FROM COLD LAKE).

MONDAY AFTERNOON WAS DEVOTED TO A TWO SESSION SYMPOSIUM ON THE TROPO-SPHERE, CHAIRED BY PROF. I.Y. ASHWELL. M. DANARD (WHO WILL SOON BE JOINING THE GROUP AT UNIVERSITY OF WATERLOO UNDER PROF. CSANADY), LED OFF THE TROPOSPHERIC CIRCULATION SESSION WITH A DISCUSSION OF A MODIFICATION TO HIS NWP MODEL (DEVELOPED TO INCLUDE THE EFFECT OF THE RELEASE OF LATENT HEAT IN RAIN AREAS) THAT INCLUDED THE EFFECT OF LONG-WAVE RADIATION. HE SHOWED THAT THIS EFFECT COULD BE UP TO TWENTY PER CENT OF THE LATENT HEAT EFFECT IN AREAS OF HEAVY RAIN. H. WILSON FOLLOWED WITH A DISCUSSION OF THE STRUCTURE OF JET-STREAMS, AND E.R. REINELT MADE A PLEA FOR NEW ANALYSIS TECHNIQUES IN WESTERN CANADA (ILLUSTRATED BY EXAMPLES OF THE EFFECT OF TERRAIN ON THE TEMPERATURE AND MOISTURE FIELDS).

THE KEYNOTE PAPER FOR SESSION II - 'ARCTIC METEOROLOGY', WAS PRESENTED BY PROF. LONGLEY OF THE UNIVERSITY OF ALBERTA. HE POINTED OUT THAT TWENTY-FIVE YEARS AGO, THE GENERAL CIRCULATION IN THE ARCTIC WAS BASED ON A SIMPLE HADLEY MODEL. HOWEVER, HIS ILLUSTRATIONS OF CYCLONE AND ANTICYCLONE TRACKS IN THE REGION SHOWED THAT THE SIMPLE MODEL IS INADEQUATE. THE ARCTIC CIRCULATION INCLUDES MOVING HIGHS AND LOWS, BUT THE MOVEMENTS ARE NOT THE SAME AS IN THE REGION OF THE WESTERLIES. FOR EXAMPLE, HIGHS AND LOWS MOVE INTO THE AREA, STAGNATE, AND THEN SUDDENLY COLLAPSE. THE SLOW MEANDERINGS ARE THE CAUSE OF SERIOUS FORECAST PROBLEMS BECAUSE ONLY SLIGHT MOVEMENT CAN CAUSE MAJOR CHANGES IN CIRCULATION AND THUS IN WEATHER.

SUMMARIZING, PROF. LONGLEY STATED THAT RADIATION BALANCE IS IMPORTANT, AND SATELLITES WILL PROVIDE MORE INFORMATION FOR RADIATION STUDIES. OTHER AREAS THAT NEED ATTENTION ARE A NEW MODEL FOR THE GENERAL CIRCULATION OF THE ARCTIC TO REPLACE THE OLD HADLEY MODEL, AND TROPOSPHERIC-STRATOSPHERIC INTERACTIONS (NOW THAT THE ARCTIC STRATOSPHERE IS KNOWN TO BE SO INTERESTING).

THIS THEME PAPER WAS FOLLOWED BY PROF. ORVIG SPEAKING ABOUT THE COMPUTATIONS THAT HE AND PROF. VOWINCKEL HAD MADE ON THE ENERGY BUDGET OF THE ARCTIC, AND INCLUDED A DEFENCE OF SOME EARLIER WORK AGAINST A CRITICISM LEVELLED BY PROF. LONGLEY IN HIS PAPER. H. WAHL THEN SPOKE ABOUT THE CLIMATOLOGICAL NETWORK (OR RATHER ITS LACK) IN THE YUKON, AND ILLUSTRATED THE NEED FOR MORE STATIONS WITH SOME COLOURED SLIDES OF THE TERRITORY. D.B. FRASER CONCLUDED THE SESSION WITH A DESCRIPTION OF A SEVERE DRAINAGE WIND UNDER AN ARCTIC INVERSION THAT OCCURS COMMONLY ON THE SHORES OF AMUNSEN GULF, AND WAS MENTIONED IN THE WRITINGS OF STEPHANSON.

TUESDAY MORNING, SESSION III OF THE SYMPOSIUM ON THE TROPOSPHERE, DEALT MAINLY WITH MATTERS RELEVANT TO ALBERTA HAIL STUDIES. PROF. W. HITSCHFELD OF MCGILL UNIVERSITY WAS THE CHAIRMAN. M.J. CURRY REPORTED ON A SENSITIVE MICRO-BAROGRAPH DEVELOPED (BY R.C. MURTY AND OTHERS) AT THE UNIVERSITY OF WESTERN ONTARIO. THE DETAIL ON PRESSURE CHANGES THAT WERE RECORDED BY THIS INSTRUMENT

WAS IMPRESSIVE. R.H. DOUGLAS THEN OUTLINED THE HISTORY OF THE MCGILL PROGRAM ON HAIL STUDIES, AND P.W. SUMMERS FOLLOWED WITH A REVIEW OF THE HISTORY OF THE ALBERTA HAIL STUDIES PROJECT. J.H. RENICK DESCRIBED A SYSTEM FOR TAKING AND ANALYZING STEREO CLOUD PHOTOGRAPHS USED BY HIM AND M. BALSHAW ON ALBERTA HAIL STUDIES. C. WARNER SHOWED TIME-LAPSE MOVIES OF A PARTICULAR STORM AND SUPPORTING RADAR PHOTOGRAPHS USED IN A SPECIAL STUDY BY HIM AND A.J. CHISHOLM. THE SAME STORM WAS MODELLED BY MRS. M. ENGLISH, WHO SHOWED HOW PREDICTIONS OF THE MODEL WERE SUPPORTED BY OBSERVATION.

THE NEXT TWO PAPERS TREATED SPECIAL OBSERVATION TECHNIQUES TO STUDY STORM CIRCULATION AND STRUCTURE. N. THYER DISCUSSED THE ANALYSIS OF SPECIAL PIBAL OBSERVATIONS AROUND SOME STORMS AND I. ZAWADZKI DESCRIBED HARPI, A NEW ELECTRONIC SYNTHESIS OF RADAR SCANS DEVELOPED AT MCGILL WITH E. BALLANTYNE (TO SUPPLEMENT CAPPI). HEIGHT-AZIMUTH-RANGE POSITION INDICATOR DISPLAYS REFLECTIVITY OF THE STORM IN A GREY-SCALE IN VERTICAL SLICES AS FUNCTIONS OF HEIGHT AND DISTANCE.

THE LAST TWO PAPERS IN THE 'STORM' SECTION OF THE SESSION DEALT WITH CHEMISTRY. G. VALLI STATED THAT NATURE PROVIDES MORE FREEZING NUCLEI THAN MAN CAN WITH SILVER IODIDE GENERATORS, AND THAT THE MOST EFFECTIVE NUCLEI IDENTIFIED IN RAINFALL SAMPLES WERE LESS THAN .01 MICRON IN DIAMETER. P. SUMMERS, SPEAKING FOR HIMSELF AND B. HITCHON, NOTED THE INTERESTING RESULT THAT THERE HAS BEEN A SUBSTANTIAL REDUCTION IN HAIL REPORTS ABOUT FORTY MILES DOWNWIND FROM MAJOR SULPHUR-PRODUCING AREAS IN THE PROVINCE. THIS HAS BEEN ACCOMPANIED BY AN INCREASE IN THE PERCENTAGE OF LESS-DAMAGING SOFT HAIL, AND A DECREASE (OVER THE LAST TWENTY YEARS) IN THE SULPHUR DEFICIENCY OF THE SOILS IN SOME AREAS. THE CONCLUSION THAT INDUSTRIAL POLLUTION IS MODIFYING THE WEATHER WAS DRAWN.

THE FINAL PAPER OF THE SESSION WAS A DESCRIPTION OF THE MARMOT CREEK PROJECT BY D. STORR. IT SERVED AS AN INTRODUCTION FOR THE FIELD TRIP TO THE SITE DURING THE AFTERNOON. AS MENTIONED IN THE FOREGOING, MR. STORR HAS PROMISED TO SUBMIT A STREAMLINED VERSION OF THE PAPER TO ATMOSPHERE.

NEXT MORNING, DR. W.L. GODSON CHAIRED THE SYMPOSIUM ON PHYSICAL METEOROLOGY. THREE PAPERS DEALT WITH CLOUD PHYSICS, TWO WITH ATMOSPHERIC ELECTRICITY, AND THREE WITH RADIATION. PROF. LIST TREATED THE SUBJECT OF TURBULENCE IN THE WAKE OF FALLING PRECIPITATION PARTICLES AND CONCLUDED THAT, WHILE IT EXISTED, IT WAS NOT SIGNIFICANT IN THE PHYSICS OF CLOUDS AND THE PARTICLES THAT CONSTITUTE THEM. G. ISAAC, SPEAKING FOR HIMSELF AND D. BISHOP, BOTH OF MCGILL, COMPARED DATA ON ICE NUCLEI IN SURFACE AIR AND IN PRECIPITATION. ICE NUCLEI WERE ALSO THE SUBJECT OF A PAPER BY R.S. SHEMENAUER AND J. MAYBANK OF THE METEOROLOGICAL BRANCH AND SASKATCHEWAN RESEARCH COUNCIL RESPECTIVELY. THEY NOTED THAT THE MAIN SOURCE OF SUCH NUCLEI AT SASKATOON WAS RURAL, AND THAT ORGANIC SOILS WERE THE MOST EFFICIENT.

BECAUSE THEIR STUDIES HAD SHOWN THAT THE PROCESSES WERE MORE COMPLEX THAN AT FIRST THOUGHT, J.E. PAKIAM AND J. MAYBANK OF THE SASKATCHEWAN RESEARCH COUNCIL DISCUSSED SOME ELECTRIC FIELD AND CONDUCTIVITY MEASUREMENTS THAT THEY



HAD MADE, INSTEAD OF THE MATTERS COVERED IN THE ABSTRACT THAT APPEARED IN THE PROGRAM. THIS WAS FOLLOWED BY THE PRESENTATION OF SOME SPECTRA AND CROSS SPECTRA OF ELECTRIC FIELD AND OTHER METEOROLOGICAL ELEMENTS BY BHARTENDU OF THE METEOROLOGICAL BRANCH.

THE FINAL THREE PAPERS DEALT WITH SOLAR RADIATION EACH IN A NOVEL WAY. FR. EAST, COLLEGE JEAN DE BREBEUF, COMPARED INSOLATION IN URBAN MONTREAL AND IN A NEARBY RURAL AREA, AND ILLUSTRATED THAT THE POLLUTED URBAN AIR DID DECREASE THE AMOUNT OF SOLAR RADIATION REACHING THE GROUND. H. FERGUSON OF THE METEOROLOGICAL BRANCH, AND A NUMBER OF COLLEAGUES, USED A PLYWOOD AND PLASTER MODEL TO ASSIST IN THE COMPUTATION OF DAILY CLEAR-SKY VALUES OF INSOLATION AT MARMOT CREEK. THE SLIDES SHOWED GRAPHICALLY THE SHADOW EFFECTS AT VARIOUS SOLAR AZIMUTHS AND ELEVATIONS. B.J. GARNIER AND A. OHMURA OF MCGILL DESCRIBED THE DEVELOPMENT OF A COMPUTER PROGRAM TO CALCULATE THE TOPOGRAPHIC VARIATIONS OF THE DIRECT SOLAR BEAM FROM OBSERVATIONS TAKEN AT ONE SITE IN AN AREA.

THE FINAL SESSION OF THE CONGRESS WAS A SYMPOSIUM ON THE ATMOSPHERIC BOUNDARY LAYER WITH PROF. CSANADY OF WATERLOO IN THE CHAIR. THE KEYNOTE SPEAKER, PROF. K. HAGE, UNIVERSITY OF ALBERTA AND AN ASSOCIATE EDITOR OF ATMOSPHERE, NOTED THAT THE PAST TWENTY YEARS HAD BROUGHT MARKED ADVANCES IN GENERAL CIRCULATION MODELS AND NUMERICAL WEATHER PREDICTION, AND HAD SEEN THE START OF A UNIFIED THEORY OF THE SURFACE BOUNDARY LAYER. FURTHER PROGRESS IN THE MODELS WOULD REQUIRE THAT THE LARGE SCALE PROCESSES BE ALLOWED TO INFLUENCE THE SMALL SCALE ONES, WHICH, IN TURN, WOULD FEED HEAT AND ENERGY BACK UP INTO THE FORMER. TWO OF THE MAJOR PROBLEMS IN BOUNDARY LAYER THESE DAYS ARE THE GAP IN UNDERSTANDING OF ENERGY EXCHANGES BETWEEN SCALES, AND THE EVALUATION OF THE MESO AND MICRO-SCALES AS SOURCES AND SINKS OF ENERGY. IN ORDER TO GET CLOSE TO THESE PROBLEMS, THERE ARE SEVERAL QUESTIONS THAT MUST BE CONSIDERED: WHAT ARE THE TIME SCALES OF THE IMPORTANT PROCESSES, AND WHAT ARE THEIR GEOGRAPHICAL AND SEASONAL TRENDS? WHAT PROCESSES CAN BE PARAMETERIZED, WHAT ARE THE KEY PARAMETERS, AND HOW ACCURATELY MUST THEY BE MEASURED? WHAT IS THE TIME RATE OF DECAY OF EACH PROCESS - THIS DETERMINES THE PREDICTABILITY OF THE PROCESS.

AT THE PRESENT TIME, ONE MUST MAKE ASSUMPTIONS. FOR THE FUTURE, HOWEVER, GARP (THE GLOBAL ATMOSPHERIC RESEARCH PROJECT) WILL SEEK THE ANSWERS TO MANY OF THESE QUESTIONS.

PROF. HAGE WENT ON TO DISCUSS SOME OF THE IMPORTANT PROCESSES WITHIN THIS CONTENT. HE ESPECIALLY NOTED THE GREAT NEED OF EXPANDED OBSERVATIONAL PROGRAMS IN ORDER TO MEET THE OBJECTIVES OF GARP. IN THIS RESPECT, HE MENTIONED SEVERAL RESEARCH PROJECTS OR PROGRAMS THAT ARE IN PROGRESS OR ADVANCED PLANNING.

FOLLOWING PROF. HAGE, P.A. TAYLOR OF THE UNIVERSITY OF TORONTO DISCUSSED HIS MATHEMATICAL MODEL OF THE EFFECTS ON FLOW OF AN ABRUPT CHANGE IN ROUGHNESS OF THE UNDERLYING SURFACE. R.M. HOLMES OF DEMR THEN SHOWED THE RESULTS OF MEASURING THE COOLING EFFECT ALOFT OF A SMALL LAKE, USING A SPECIALLY

EQUIPPED LIGHT PLANE. THE EFFECT (OR LACK THEREOF) OR MINOR TERRAIN FEATURES ON PRECIPITATION DISTRIBUTION WAS THE SUBJECT OF THE PAPER BY R.B.B. DICKISON OF THE METEOROLOGICAL BRANCH. IN THE DISCUSSION OF ICE ACCRETION ON WIRES AND TOWERS BY G.A. MCKAY AND H.A. THOMPSON OF THE METEOROLOGICAL BRANCH, THE LATTER SHOWED A SLIDE WITH "ICYPLETHS" OF FREQUENCY OF OCCURRENCE OF FREEZING PRECIPITATION. J.A. MCCALLUM OF METEOROLOGICAL BRANCH PRESENTED BOTH HIS PAPER AND THAT OF JOHNSON AND LARSEN WHICH PRECEDED IT ON THE PROGRAMS. BOTH PAPERS DEALT WITH THE SUFFIELD EXPERIMENTS ON DIFFUSION IN THE BOUNDARY LAYER USING VERY SMALL GLASS SPHERES. THE CHAIRMAN, G.T. CSANADY, COMPLETED THE SESSION WITH HIS PAPER ON THE DIFFUSION OF A LARGE CLOUD IN THE BOUNDARY LAYER.

FORTY-NINE PAPERS HAD BEEN ACCEPTED FOR THE SCIENTIFIC SESSIONS. OF THESE, SIX WERE PRESENTED BY TITLE ONLY, FORTY-TWO WERE PRESENTED BY ONE OF THE AUTHORS, AND ONE BY A STAND-IN. IN FIVE HALF DAYS, MUCH WAS ACCOMPLISHED.

#### ANNUAL BUSINESS MEETING

ON MONDAY EVENING, JUNE 3, MEMBERS RETURNED TO THE ENGINEERING BUILDING FOR THE ANNUAL BUSINESS MEETING. IT WAS CALLED TO ORDER AT 1930 BY THE PRESIDENT, PROF. A.W. BREWER. THE FIRST ORDER OF BUSINESS WAS THE PRESENTATION OF THE 1967 PATTERSON MEDAL TO PROF. BALFOUR CURRIE OF THE UNIVERSITY OF SASKATCHEWAN AT SASKATOON. STANDING IN FOR J.R.H. NOBLE, DIRECTOR OF THE METEOROLOGICAL BRANCH, WHO WAS IN GENEVA, WAS D. SMITH, REGIONAL METEOROLOGIST AT EDMONTON.

FOLLOWING PROF. CURRIE'S REMARKS, THE MINUTES OF THE FIRST ANNUAL BUSINESS MEETING, THE REPORTS OF COUNCIL, THE TREASURER, THE AUDITOR, THE NOMINATING COMMITTEE AND THE PRIZE COMMITTEE WERE ACCEPTED AS PRINTED WITH LITTLE COMMENT. THE CHAIRMAN CONGRATULATED THE VARIOUS PRIZE WINNERS, AND ANNOUNCED THE ESTABLISHMENT OF THE ANDREW THOMSON AWARD FOR UNDERGRADUATE STUDENTS. REPRESENTATIVES OF THE LOCAL CENTRES PRESENTED REPORTS.

THE REPORT OF THE EDITOR AND THE PROPOSED PUBLICATION POLICY FOR ATMOSPHERE GENERATED CONSIDERABLE DISCUSSION. THERE WERE MANY COMPLAINTS ABOUT THE DELAYS IN PRINTING AND DISTRIBUTION, AND NON-RECEIPT OF ISSUES BY SOME MEMBERS. THE PROPOSAL WAS ACCEPTED AS PRINTED EXCEPT FOR A MOTION THAT THE TRANSACTIONS AND BUSINESS OF THE SOCIETY BE REPORTED IN AN OFFICIAL PUBLICATION OF THE SOCIETY; OF COURSE, AT THE PRESENT, ATMOSPHERE IS THE ONLY SUCH PUBLICATION.

THERE WAS ALSO DISCUSSION ABOUT THE BUDGET PROPOSAL, AND THE MOTION REGARDING AN INCREASE IN FEES FOR 1969 THAT CAME FROM COUNCIL. A MOTION FROM THE FLOOR INCREASED THE FEES TO \$7.50 FOR MEMBERS, LEAVING THE ANNUAL MEMBERSHIP FEE FOR STUDENTS AT \$1.00.

SEVERAL ANNOUNCEMENTS OF INTEREST WERE MADE. THE ONE ABOUT THE FORMATION OF LOCAL CENTRES AT SASKATOON AND QUEBEC CITY WAS MET WITH ENTHUSIASM BY THOSE PRESENT. AN INVITATION TO JOIN THE ROYAL AND THE AMERICAN METEOROLOGICAL

SOCIETIES AS A CO-SPONSOR OF A MEETING IN LONDON IN 1970 DEALING WITH GARP WAS PRESENTED, AND IT WAS LEFT TO COUNCIL TO CONSIDER THE QUESTION.

FOLLOWING ADJOURNMENT AT 2140, A RECEPTION WAS HELD IN THE ENGINEERS' LOUNGE.

#### G A R P   W O R K S H O P

ON FRIDAY, JUNE 7, THE SOCIETY WAS CO-SPONSOR WITH THE METEOROLOGICAL BRANCH AND THE SUB-COMMITTEE ON METEOROLOGY AND ATMOSPHERIC SCIENCES (OF THE N.R.C. ASSOCIATE COMMITTEE ON GEOPHYSICS) OF THIS WORKSHOP. ITS PURPOSE WAS TO BRING TOGETHER SOME OF THE CANADIAN SCIENTISTS WHO WOULD BE PARTICIPATING IN GARP IN ORDER TO GIVE PRELIMINARY CONSIDERATION INTO WHAT CANADA'S ROLE SHOULD BE.

AN HISTORICAL INTRODUCTION TO GARP WAS GIVEN BY PROF. R.W. STEWART (INSTITUTE OF OCEANOGRAPHY, UNIVERSITY OF BRITISH COLUMBIA) WHO IS VICE-CHAIRMAN OF THE JOINT ORGANIZING COMMITTEE FORMED BY WMO AND IUGG. DR. W.L. GODSON FOLLOWED WITH A DISCUSSION OF THE STATUS OF SOME OF THE TOOLS - INSTRUMENTS AND FACILITIES THAT WOULD BE REQUIRED IN THE PROGRAM. BRIEF BACKGROUND PAPERS ON VARIOUS RELEVANT SUBJECTS WERE PRESENTED BY SEVERAL OF THE PARTICIPANTS.

IN THE NEXT STAGE, THE PARTICIPANTS DIVIDED THEMSELVES INTO PANELS - BOUNDARY LAYER (UNDER R.W. STEWART) AND FREE ATMOSPHERE (UNDER W.L. GODSON) - FOR FURTHER DISCUSSION. THEN THE TWO PANELS REJOINED TO SHARE RESULTS.

THESE DISCUSSIONS SHOULD PROVIDE A GOOD POINT OF DEPARTURE FOR DETAILED PLANNING OF CANADA'S ROLE IN GARP.

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