Atmosphere

8th ANNUAL CONGRESS

May 29-31

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ATMOSPHERE

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THE CANADIAN METEOROLOGICAL SOCIETY

CONTENTS

EIGHTH ANNUAL CONGRESS

CANADIAN METEOROLOGICAL SOCIETY

The Eighth Annual Congress and Annual Meeting of the Canadian Meteorological Society will be held at York University, Downsview (Toronto), Ontario, 29-31 May 1974. The theme of the Congress is "Meteorology and the Community" with the stress on the communication of meteorological information to the general community. The morning of May 29 will be devoted to two sessions on weathercasting. In the first session four papers on weathercasting will be presented. This will be followed by a panel discussion on weathercasting. The panelists with backgrounds in both radio and television, some with and others without meteorological background, will discuss the topic "Weathercasts should NOT be done by weathermen". In addition, there will be twenty other technical sessions taking place on the afternoon of May 29 and all day May 30 and 31. Program Chairman for the Congress is Dr. G. A. McBean.

The Toronto Centre of the CMS is host for the Congress. Chairman of the Local Arrangements Committee is R. A. Miller, Atmospheric Environment Service, Downsview.

SUMMARY OF SESSIONS

Wednesday, May 29

8:30 a.m.		Opening Welcome
8:45 a.m.	1	Weathercasting, Part I
10:45 a.m.	2	Weathercasting, Part II - panel discussion
1:30 p.m.	3	Forecast Research, Part I
1:30 p.m.	4	Weather Modifications
3:30 p.m.	5	Forecast Research, Part II
3:30 p.m.	6	Plume Studies
Evening		Annual General Meeting of the CMS followed by a Wine and Cheese Party

Thursday, May 30

8:30 a.m.	7	Meteorology and Community
9:30 a.m.	8	Atmospheric Electricity, Part I
10:30 a.m.	9	Atmospheric Electricity, Part II
10:30 a.m.	10	Dynamical Meteorology, Part I
1:30 p.m.	11	Atmospheric Electricity, Part III
1:30 p.m.	12	Dynamical Meteorology, Part II
3:30 p.m.	13	Atmospheric Electricity, Part IV
3:40 p.m.	14	Dynamical Meteorology, Part III
Evening		Banquet and awards presentation, Ontario Place

Friday, May 31

8:30	a.m.	15 Rain, Hail and Fog
8:30	a.m.	16 Micrometeorology, Part I
10:40	a.m.	17 Remote Sensing, Part I
10:40	a.m.	18 Micrometeorology, Part II
1:30	p.m.	19 Remote Sensing, Part II
1:30	p.m.	20 Urban Meteorology
3:30	p.m.	21 Remote Sensing, Part III
3:30	p.m.	22 General Meteorology

PROGRAM

Wednesday Morning 29 May 1974 8:30 - 8:45 a.m.

Opening Welcome: Dr. J. W. Yolton, Acting President
York University

Dr. W. F. Hitschfeld, President
Canadian Meteorological Society

SESSION 1 *Weathercasting - Part I* 8:45 - 10:15 a.m.

Chairman K. T. McLeod

MEET YOUR WEATHER MAN
R. A. Hornstein, Halifax

DESIGNING AND DELIVERING WEATHER ADVICE FOR THE PUBLIC
L. K. McGlening, Atmospheric Environment Service, Toronto

PUBLIC RESPONSE TO WEATHER TERMINOLOGY - A CASE STUDY
G. R. McBoyle, University of Waterloo

PRESENTING THE PUBLIC FORECAST
R. V. Dexter, Halifax

Coffee (10:15 - 10:45)

SESSION 2 *Weathercasting - Part II* 10:45 - noon

PANEL DISCUSSION

Subject: Weathercasts should NOT be done by weathermen

Moderator: R. Lee, Atmospheric Environment Service, Downsview

Panelists: Dave Devall, CFTO-TV, Toronto
Reid Dexter, Halifax
Rube Hornstein, Halifax
Tayler Parnaby, CKEY-Radio, Toronto

Wednesday Afternoon 29 May 1974 1:30 - 3:00 p.m.

SESSION 3 *Forecast Research - Part I*

Chairman: Richard Asselin

A SEMI-IMPLICIT GLOBAL MULTI-LEVEL PRIMITIVE EQUATIONS MODEL
Roger Daley, Atmospheric Environment Service, Montreal

A MODEL FOR MESOMETEOROLOGICAL INFLUENCES OF TOPOGRAPHY ON SURFACE WINDS OVER TORONTO AND VICINITY
Maurice B. Danard, University of Waterloo

USE OF THE SEMI-IMPLICIT SCHEME IN A CONVECTIVE MODEL
Claude Girard, Atmospheric Environment Service, Montreal

AN APPLICATION OF BOUNDARY LAYER PARAMETERIZATION STUDIES TO AN AIRCRAFT ACCIDENT INVESTIGATION
Bryan R. Kerman, Atmospheric Environment Service, Downsview

SESSION 4 *Weather Modifications* 1:30 - 3:00 p.m.

Chairman: W. Hitschfeld

AN ALBERTA WEATHER MODIFICATION SURVEY
E. P. Lozowski, University of Alberta

THE POTENTIAL ATMOSPHERIC ENVIRONMENTAL EFFECTS OF EXTENSIVE DEVELOPMENT OF THE ATHABASCA TAR SANDS
P. W. Summers, Atmospheric Environment Service, Downsview

A COMPARISON OF THE WATER BUDGET PARAMETERS OF URBAN AND RURAL CONVECTIVE RAIN CLOUDS IN THE MIDWESTERN UNITED STATES
R. C. Grosh and R. G. Semonin, Illinois State Water Survey, Urbana, Illinois

ESTIMATES OF NORMALIZED ATMOSPHERIC POLLUTANT CONCENTRATIONS AT COME-BY-CHANCE, NEWFOUNDLAND
R. V. Portelli and J. L. Walmsley, Atmospheric Environment Service Downsview

Coffee (3:00 - 3:30)

SESSION 5 *Forecast Research - Part II* 3:30 - 5:00 p.m.

Chairman: George Pincock

FIRST PRECIPITATION FORECASTS FROM THE DPR MODEL ON THE CDC 7600
David Davies and D. W. Shantz, Atmospheric Environment Service
Montreal

PROBABILITY OF PRECIPITATION FORECASTS USING CLASSIFIED AND LINEAR PREDICTORS
N. Yacowar, Atmospheric Environment Service
Montreal

ON LEE CYCLOGENESIS AND AIRFLOW IN CANADIAN ROCKY AND EAST ASIAN MOUNTAINS
Yong-S. Chung, Atmospheric Environment Service, Downsview and
K. D. Hage and Erhard R. Reinelt, University of Alberta

AN ENERGY INDEX FOR THE DIAGNOSIS AND PREDICTION OF SHOWERS AND THUNDERSTORMS
Wm. S. Harley, Atmospheric Environment Service, Downsview

SESSION 6 *Plume Studies* 3:30 - 5:00 p.m.

Chairman: W. R. Frisken

BUOYANT PLUME RISE: AN EXAMINATION OF BRIGGS' EQUATIONS
J. L. Walmsley, Atmospheric Environment Service, Downsview

THERMAL PLUMES IN AN URBAN ENVIRONMENT
D. R. Hay and V. E. Sells, University of Western Ontario

ON THE BIFURCATION OF BUOYANT PLUMES
F. H. Fanaki, Atmospheric Environment Service, Downsview

SOME CONSEQUENCES OF THE PLUME BIFURCATION PHENOMENON IN OCEANIC AND ATMOSPHERIC ENVIRONMENT
M. L. Khandekar, University of Alberta and
T. S. Murty, Marine Sciences Directorate, Ottawa

Thursday Morning 30 May 1974

SESSION 7 *Meteorology and Community* 8:30 - 9:30 a.m.

Chairman: F. W. Benum

ENVIRONMENTAL IMPACT ASSESSMENT: PRINCIPLES AND PROCEDURES
R. E. Munn, Atmospheric Environment Service, Downsview

URBAN PLANNING UTILIZING A REGIONAL ATMOSPHERIC SIMULATION MODEL
A. E. Boyer, Ministry of the Environment, Toronto

SESSION 8 *Atmospheric Electricity - Part I* 9:30 - 10:00 a.m.

Chairman: B. W. Currie

SURVEY ON THE APPLICABILITY OF ATMOSPHERIC ELECTRICITY (Invited Paper)
Hans Dolezalek, Office of Naval Research
Arlington, Virginia

Coffee (10:00 - 10:30)

SESSION 9 *Atmospheric Electricity - Part II* 10:30 - noon

Chairman: Hans Dolezalek

ATMOSPHERIC ELECTRICITY AND THE COMMUNITY
D. R. Lane-Smith, University of Western Ontario
Bhartendu, Atmospheric Environment Service, Downsview and
J. V. Iribarne *et al*, University of Toronto

THE EQUILIBRIUM CHARGE DISTRIBUTION ON SUB MICRON AEROSOLS
W. J. Megaw, York University

POSITIVE AND NEGATIVE ION MOBILITY SPECTRA OF SPRAY PRODUCED IONS
B. A. Thomson and J. V. Iribarne, University of Toronto

ARE METEOROLOGICAL VARIABLES RELATED TO ATMOSPHERIC ELECTRICITY PARAMETERS?
R. G. Lawford and Bhartendu, Atmospheric Environment Service,
Downsview

SESSION 10 *Dynamical Meteorology - Part I* 10:30 - noon

Chairman: B. W. Boville

THE INFLUENCE OF OROGRAPHY AND SURFACE FRICTION ON SYNOPTIC SCALE VERTICAL MOTION OVER WESTERN CANADA
G. R. Schram and M. L. Khandekar, University of Alberta

THE ADJUSTMENT OF THE WIND FIELD TO SMALL SCALE TOPOGRAPHY IN A NUMERICAL WEATHER PREDICTION MODEL
H. Allard and J. Derome, McGill University

ON THE ORIGIN OF MOUNTAIN-ASSOCIATED WAVES IN WESTERN NORTH-AMERICA
E. R. Reinelt and D. Oracheski, University of Alberta

A DIAGNOSTIC STUDY OF AN INTENSE MESOSCALE DISTURBANCE IN THE BOMEX AREA
S. M. Daggupaty, C. L. Smith, E. J. Zipser and L. Sapp,
National Center for Atmospheric Research, Boulder, Colorado

THE ATMOSPHERIC ENERGY BUDGET OF THE HEMISPHERES
G. J. Boer, Atmospheric Environment Service, Downsview

Thursday Afternoon 30 May 1974

SESSION 11 *Atmospheric Electricity - Part III* 1:30 - 3:00 p.m.

Chairman: Bhartendu

PERTURBATION OF ATMOSPHERIC ELECTRIC PROCESSES DURING AN ECLIPSE
D. R. Lane-Smith and R. Markson, University of Western Ontario

THE ELECTRIFICATION AND FRAGMENTATION OF FREEZING DROPS
R. J. Kolomeychuk, J. V. Iribarne and D. C. McKay,
University of Toronto

ELECTROSTATIC METHODS FOR REMOTE SENSING OF PLUMES
W. L. Boeck, Niagara University, New York, and
B. Vonnegut, Atmospheric Sciences Research Center,
State University of New York at Albany, Albany, New York

THE RADIOACTIVE SOURCE AS A POTENTIAL PROBE
D. R. Lane-Smith, University of Western Ontario

SESSION 12 *Dynamical Meteorology - Part II* 1:30 - 3:10 p.m.

Chairman: A. Robert

MODELLING OF THE STATIONARY PLANETARY WAVES IN THE STRATOSPHERE
C. Beaudoin and J. Derome, McGill University

THE GREEN FLASH AND CLEAR AIR TURBULENCE
A. B. Fraser, Pennsylvania State University

SUB-GRIDSCALE TURBULENCE
P. E. Merilees, University Corporation for Atmospheric Research
Boulder, Colorado

INTERACTION BETWEEN GRAVITY WAVES AND BASIC FLOW
M. Shabbar, Atmospheric Environment Service, Downsview

FOURIER TECHNIQUES ON THE GLOBE
G. J. Boer and L. Steinberg, Atmospheric Environment Service
Downsview

Coffee (3:00 - 3:30)

SESSION 13 *Atmospheric Electricity - Part IV* 3:30 - 5:00 p.m.

Chairman: D. R. Lane-Smith

AN INTERVALOMETER FOR SFERICS DIRECTION FINDING AT 73.6 MHZ
D. C. Scouten and David T. Stephenson, Iowa State University
Ames, Iowa

IMPROVED RADIO-LOCATION OF LIGHTNING
J. Percey and E. J. Stansbury, McGill University

VARIATION OF V.L.F. SPECTRA WITH RANGE FOR LIGHTNING
SFERICS FROM SOURCES AT INTERMEDIATE RANGES
W. D. MacClement and R. C. Murty, University of Western
Ontario

ELECTRICAL PROCESSES AND THUNDER GENERATION
Bhartendu, Atmospheric Environment Service, Downsview

SESSION 14 *Dynamical Meteorology - Part III* 3:40 - 5:00 p.m.

Chairman: M. B. Danard

A ZONALLY AVERAGED CIRCULATION MODEL OF THE STRATOSPHERE INCORPORATING RADIATIVE HEATING AND OZONE PHOTOCHEMISTRY IN AN OXYGEN-HYDROGEN-NITROGEN ATMOSPHERE
R. K. Rao-Vupputuri, Atmospheric Environment Service Downsview

A PARAMETERIZED MODEL FOR THE CALCULATION OF LONG-WAVE RADIATIVE FLUXES IN THE ATMOSPHERE
S. F. Woronko, Atmospheric Environment Service, Downsview

A DIAGNOSTIC STUDY ON THE EVOLUTION OF AN INTENSE TROPICAL MONSOON DEPRESSION
S. M. Daggupaty, National Center for Atmospheric Research, Boulder, Colorado and D. R. Sikka, Indian Institute of Tropical Meteorology, Poona-5, India

BOUNDS ON SOLUTIONS TO NONLINEAR REACTION-DIFFUSION EQUATIONS
F. J. Testa, Atmospheric Environment Service, Downsview

Friday Morning 31 May 1974

SESSION 15 *Rain, Hail and Fog* 8:30 - 10:10 a.m.

Chairman: P. W. Summers

ICE FOG AT ARCTIC AIRPORTS
R. G. Lawford, M. O. Berry and I. Savdie, Atmospheric Environment Service, Downsview

THE OBJECTIVE MEASUREMENT OF ALBERTA HAIL
G. S. Strong and E. P. Lozowski, University of Alberta

RADAR ANALYSIS OF FLASH FLOOD PRODUCING STORMS
G. L. Austin and L. B. Austin, McGill University

COLLECTION EFFICIENCIES OF ARTIFICAL HAILSTONES
R. Stewart and R. List, University of Toronto

SEVERE LOCAL STORMS IN SOUTHERN SASKATCHEWAN - 27 AUGUST 1973
A. H. Paul, University of Saskatchewan, Regina (to be presented by E. P. Lozowski)

SESSION 16 *Micrometeorology - Part I* 8:30 - 10:10 a.m.

Chairman: K. D. Hage

LOG-LINEAR WIND AND TEMPERATURE PROFILES OVER A ROUGH TERRAIN DURING INVERSION CONDITIONS
S. SethuRaman and R. M. Brown, Brookhaven National Laboratory, Upton, New York

THE NOCTURNAL INVERSION: A THEROETICAL VIEW
Y. Delage, Atmospheric Environment Service, Montreal

A SPECTRUM OF MESO-SCALE TURBULENCE
B. R. Kerman, Atmospheric Environment Service, Downsview

GENERATION OF TEMPERATURE FLUCTUATIONS BY STATIC PRESSURE FLUCTUATIONS IN THE ATMOSPHERIC BOUNDARY LAYER
C. A. Friehe, University of California, San Diego

FLUX MEASUREMENTS ON LAKE SIMCOE
H. C. Martin, Atmospheric Environment Service, Downsview

Coffee (10:10 - 10:40)

SESSION 17 *Remote Sensing - Part I* 10:40 - noon

Chairman: R. W. Nicholls

LIDAR POLARIZATION ANALYSIS OF THE LOWER TROPOSPHERE
J. D. Houston, S. R. Pal, and A. I. Carswell, York University

SPECTROPHOTOMETRIC MEASUREMENTS OF ATMOSPHERIC NITROGEN DIOXIDE
A. W. Brewer, University of Toronto,
J. B. Kerr, Atmospheric Environment Service, Downsview and
C. T. McElroy, University of Toronto

FIELD TESTS OF A MICHELSON INTERFEROMETER
W. A. Gault, York University

LIDAR BACKSCATTERING FROM CIRRUS CLOUDS AND INVERSION LAYERS
S. R. Pal, J. D. Houston, and A. I. Carswell, York University

SESSION 18 *Micrometeorology - Part II* 10:40 - noon

Chairman: G. A. McBean

TOWARDS THE BULK PARAMETERIZATION OF THE ATMOSPHERIC BOUNDARY LAYER
I. Edwards and B. R. Kerman, Atmospheric Environment Service, Downsview

URBAN BOUNDARY LAYER STRUCTURES
R. C. Bennett and R. List, University of Toronto

RESULTS FROM SEA TRIALS OF A NEW BOUNDARY LAYER TETHERSONDE PACKAGE
R. E. Mickle and D. S. Davison, Atmospheric Environment Service, Downsview

EXPERIMENTS WITH THE ENERGY AND WATER BUDGETS OF THE CANADIAN MIDDLE NORTH. EXAMPLES FOR THE PAS, MANITOBA
E. Vowinckel and S. Orvig, McGill University

Friday Afternoon 31 May 1974

SESSION 19 *Remote Sensing - Part II* 1:30 - 3:00 p.m.

Chairman: A. W. Brewer

AIRBORNE MEASUREMENTS RELATED TO WATER QUALITY
J. R. Miller, York University

AN AIRBORNE FM-CW RADAR FOR MONITORING SMALL SCALE ATMOSPHERIC LAYERING EFFECTS
J. H. Davies and V. Ward, Barringer Research, Toronto

LINE SCANNING OF FRESH WATER BODIES
K. S. Gordon, York University

A SENSITIVE LASER METHOD FOR MEASURING WATER VAPOUR CONCENTRATION
Z. Kucerovsky, and E. Brannen, The University of Western Ontario

SESSION 20 *Urban Meteorology* 1:30 - 3:00 p.m.

Chairman: T. L. Wiacek

THE USE AND ABUSE OF THE URBAN MIXING DEPTH CONCEPT
P. W. Summers, Atmospheric Environment Service
Downsview

SEASONAL EXCESS URBAN ENERGY AND THE NOCTURNAL HEAT ISLAND-TORONTO
D. Yap, Atmospheric Environment Service, Downsview

PRELIMINARY RESULTS OF AN ATTEMPT TO PARAMETERIZE THE ENERGETICS OF AN URBAN CANYON
M. Nunez and T. R. Oke, University of British Columbia

PLUME RISE MEASUREMENTS IN THE SUDBURY AREA
F. H. Fanaki, Atmospheric Environment Service, Downsview

ATMOSPHERIC POLLUTANT AND TEMPERATURE TRAVERSES IN AN URBAN AREA
T. J. Lyons, The Flinders University of South Australia, Australia, and D. R. Cutten, Australian Defence Scientific Service, Australia

Coffee (3:00 - 3:30)

SESSION 21 *Remote Sensing - Part III* 3:30 - 5:00 p.m.

Chairman: P. G. Aber

LIDAR STUDIES OF SMOKE PLUMES-A PROBLEM IN APPLIED METEOROLOGY
S. Peteherych, J. D. Houston, S. R. Pal and A. I. Carswell,
York University

THE MEASUREMENT OF MICROMETEOROLOGICAL TEMPERATURE PROFILES BY THE INVERSION OF OPTICAL DATA
A. B. Fraser and W. H. Mach, The Pennsylvania State University,
University Park

MEASUREMENT OF VERTICAL AIR MOTIONS IN THE PLANETARY BOUNDARY LAYER USING AN ACOUSTIC ECHO-SOUNDER
H. Melling, R. List, R. C. Bennett and U. W. Rentsch,
University of Toronto

ATMOSPHERIC INSTRUMENTS NEW MARK II SODAR
M. G. Woodhead and W. L. Clink, Atmospheric Environment Service,
Downsview

SESSION 22 *General Meteorology* 3:30 - 5:00 p.m.

Chairman: L. K. McGlening

LINE ORIENTATION AS A FACTOR IN ICE AND SNOW ACCUMULATION ON OVERHEAD UTILITY WIRES

M. Pancura, B. A. Power and G. Larson,
Weather Engineering Corporation of Canada, Ltd., Montreal

CLOSED DRAINAGE LAKES ARE A CLIMATIC CHANGE INDICATOR

J. Whiting, Saskatchewan Research Council

PRESSURE SURFACES, CRITICAL ELEMENTS, AND NETWORK REPRESENTATIONS FOR DESCRIPTION, ANALYSIS, AND PREDICTION OF STRUCTURES AND FLOWS

W. Warntz and N. Waters, University of Western Ontario

INTRODUCING METEOROLOGY TO SCHOOLS AND THE PUBLIC THROUGH NON-NUMERICAL SIMULATIONS

R. G. Lawford, Atmospheric Environment Service, Downsview

ABSTRACTS

Session 1: Weathercasting - Part I

MEET YOUR WEATHERMAN
R. A. Hornstein

No group of public servants is as continuously, although anonymously, visible to 22,000,000 Canadians as those members of the Atmospheric Environment Service who provide the daily weather forecasts. Despite benefits that may follow from research, care must be taken to balance energy expended on project work with that devoted to ensuring that the general Canadian public is being provided with the highest possible level of meteorological service on a day-to-day basis. Some practical proposals for achieving this objective are presented.

DESIGNING AND DELIVERING WEATHER ADVICE FOR THE PUBLIC
L. K. McGlening

The Atmospheric Environment Service provides a variety of specially-designed weather information and advice to meet the needs of the general public and to serve the requirements of the mass media. These public weather services are described and the problems associated with their design discussed. Present methods used to distribute the information are detailed including the arrangements for providing the material to the press, radio and television. The advantages and disadvantages of current practices are evaluated. Present and planned utilisation of new communication methods are described including the facilities offered by cable television, automatic telephone announcement systems, dedicated radio frequencies and communication satellites.

PUBLIC RESPONSE TO WEATHER TERMINOLOGY - A CASE STUDY
G. R. McBoyle

Monitoring of the public's understanding of weather forecast terminology has existed since the '40's, but doubts have been expressed whether in fact the accuracy of the public's understanding of forecast terms has kept abreast of the increasing accuracy of actual forecasts.

An attempt to assess public understanding of weather terminology for the Kitchener-Waterloo region in Ontario was carried out by questionnaire in late winter of 1973. The weather terms, on which the public were questioned were obtained from content analysis of local media - newspaper, TV and radio stations. The terms were categorized into three groups:-

a) terms with a definite meteorological meaning obtained from MANPUB, (an operational manual of AES).
b) terms in the operational manual, generally understood but with no set meaning
and c) terms used by the media but not found in the manual.

The analysis deals with at least fourteen specific terms e.g. "overcast", "clear", "sunny", "mostly sunny". The overall results indicate that public understanding of definitions of weather terms is poor and that certain common forecasting terms are widely misinterpreted. To improve the accuracy of the forecasts, therefore, either the public must be re-educated to associate the official meaning with the use of the term or official meaning of terms must be more in key with general understanding of them. Where, for example, considerable consensus exists for a "wrong" meaning then there may be some validity in considering re-definition.

Maybe the time has come for the official agency to be responsible and accountable for their "verification" at the "customer" level, as well as "verification" at the meteorological forecasting scientific level.

PRESENTING THE PUBLIC FORECAST

R. V. Dexter,

The general public's low opinion of the accuracy of the daily forecasts as disseminated by radio is discussed. Forecast accuracy for the first 12 hours has certainly not improved significantly in the past 27 years. A few simple suggestions are given for achieving some improvement now, but it is argued that forecast presentations require drastic change to take full account of the fact that forecasts are frequently wrong.

Personal opinions on how to improve upon the present unsatisfactory system are given, based upon experience as a successful presenter of forecasts on early morning radio.

Session 2 Weathercasting - Part II

PANEL DISCUSSION–WEATHERCASTS SHOULD NOT BE DONE BY WEATHERMEN

R. Lee, D. Devall, R. Dexter, R. Hornstein, T. Parnaby

Session 3 Forecast Research - Part I

A SEMI-IMPLICIT GLOBAL MULTI-LEVEL PRIMITIVE EQUATIONS MODEL

R. Daley

Work has been continuing for the last year on developing a global, spectral, multi-level, primitive equations model suitable for medium and short-range forecasting. The approach adopted has been similar to that of Bourke (1973). That is, all horizontal operations involve the use of spherical harmonic expansions and the use of spectral-grid transforms.

The model as presently coded includes orography, surface drag, vertical eddy momontum transport and a dry convective adjustment. Surface heating is in the process of being added and programs for the inclusion of moisture, latent heat release and moist convective correction are in an advanced state. It is expected that existing DPR radiation programs will be incorporated.

The model is designed to run from either global or hemispheric initial conditions with initial balance requirements apparently not being very stringent. A series of ten varied test cases have been run from real northern hemisphere data and 36 hour forecasts obtained. The results, when compared with the atmosphere and other models, were very encouraging.

A MODEL FOR MESOSCALE INFLUENCES OF TOPOGRAPHY ON SURFACE WINDS OVER TORONTO AND VICINITY

Maurice Danard

Topographic effects (orography, differential friction, and differential heating) on surface winds over Toronto and vicinity are studied using a one-level primitive equations model.

Initially the surface wind is computed assuming a balance between pressure gradient, Coriolis and friction forces. The initial pressure field is obtained from synoptic charts. Different drag coefficients are employed for land and water. The height of the Ekman layer depends on the stability. The model then calculates the temperature changes in the lowest kilometer due to flow over orographic obstacles and due to heating and cooling by the underlying surface. The model is capable of simulating thermodynamic influences such as upslope and downslope winds, and lake-and land-breezes.

The grid size is 5 km. Computed winds for June 11, 1973 (the hottest day of the month) are verified with those measured by the Toronto mesometeorological network.

USE OF THE SEMI-IMPLICIT SCHEME IN A CONVECTION MODEL

Claude Girard

The semi-implicit time integration scheme has been used with success in the numerical integration of the primitive equations in large scale meteorology for the purpose of eliminating timestep restrictions due to gravity wave propagation. The feasibility of applying the same technique in the modeling of convective phenomena using the full equations is being investigated. This method of eliminating timestep restrictions due to sound wave propagation is compared with the filtering method by which approximate equations are derived, that do not admit sound waves as particular solutions.

AN APPLICATION OF BOUNDARY LAYER PARAMETERIZATION STUDIES TO AN AIRCRAFT ACCIDENT INVESTIGATION

Bryan R. Kerman

The method of Rossby number similarity is used to establish estimates of the wind and turbulent structure at the place and time of an aircraft accident. The estimated surface stress which is derived from the so-called resistance laws is used to denormalize the similarity relationships for the vertical distributions of wind speed, turbulent energy and stress and characteristic size of the large energy-containing eddies. These parameters in turn descale the spectral distributions of turbulent energy. From the turbulent spectra, it is possible to estimate the aircraft response and exceedance characteristics given the transfer properties of the aircraft. Finally, a sample realization of turbulence is simulated based on the method of the synthesis of digital filters. It is suggested that such methods, with improved empiricism, might be extended profitably to other applications of boundary layer parameterization studies.

AN ALBERTA WEATHER MODIFICATION SURVEY

E. P. Lozowski

Between June 15 and July 31, 1973, the Alberta Weather Modification Board circulated a survey among farmers in south central Alberta, in order to determine their understanding of, and attitudes towards weather modification in the Province. Two home economists with no previous weather modification exposure personally interviewed 399 farm residents (about a 4 per cent sample), selected according to a predetermined but arbitrary geographical criterion which was designed to include two farmers per township.

The complete survey encompassed most of the target area in which commercial hail suppression had been undertaken between 1956 and 1968, and a similar adjacent area to the north which had been largely outside the commercial target area. This made it possible to try to assess the effect on attitudes, of previous experience with commercial weather modification. The natural decrease in precipitation from west to east in the area was also found to affect the farmers' opinions, especially towards rain stimulation.

Overall, the answers and comments on the questionnaires suggest that the farming community is cautiously optimistic about the anticipated beneficial effects of weather modification. Nevertheless, many farmers felt they would like to know more about weather modification, and few were willing to undertake a personal financial commitment without further evidence of benefits.

THE POTENTIAL ATMOSPHERIC ENVIRONMENTAL EFFECTS OF EXTENSIVE DEVELOPMENT OF THE ATHABASCA TAR SANDS

Peter W. Summers

The rapid development of the Athabasca Tar Sands could produce within a decade total SO_2 emissions (assuming no near-term breakthrough in stack SO_2 removal technology) approaching, or even at times exceeding, those of the Sudbury area. In addition, the combustion processes and the discharge of vast quantities of hot water into large tailings ponds will inject a large amount of water vapour into the atmosphere, thus increasing the frequency of water and ice fog in the area.

Since these SO_2 and water vapour emissions will occur in a region with a severe arctic type climate and within a restricted valley, the potential for adverse effects due to only a few operating oil extraction plants is thus very high. The various atmospheric environmental considerations are discussed, and the research required to solve the many meteorological problems so that the adverse effects are minimized is outlined.

A COMPARISON OF THE WATER BUDGET PARAMETERS OF URBAN AND RURAL CONVECTIVE RAIN CLOUDS IN THE MIDWESTERN UNITED STATES

R. C. Grosh and R. G. Semonin

METROMEX (METROpolitan Meteorological EXperiment) is a 5 year program to study the enhancement of precipitation and severe weather which is observed 10-15 miles east of St. Louis. The METROMEX field project, involving several research groups from various institutions, is seeking to 1) delineate the frequency and areal extent of the weather anomalies, and 2) to discern the causative

factors involved in order to transfer the findings to other urban areas.

As a part of this effort, case studies of selected storms are being performed to determine how the urban environment affects individual rainstorms. In this paper observations of the growth rates and precipitation fluxes of rainstorms which occurred near or over St. Louis during 3 days in the summer of 1972 will be presented. All three days were characterized by heavy rain. Hailfalls were also noted on two of the days. The limited observations permit a direct comparison of the effects of the urban and rural environments on storm cell development.

The storms were observed by the radars of the ISWS (a 10-cm FPS-18 and a 3-cm TPS-10) and the University of Chicago (a 3-cm TPS-10). Radar observations were recorded on magnetic tape and microfilm. Most of the storm cells examined also passed through the ISWS 250-raingage network. Raincells were analyzed from the plots of the 5-minute rainfall rates obtained from the raingage charts. The radar and raingage observations were used to determine the volumes, liquid water contents and rain fluxes of individual storm cells as functions of time. Supporting data obtained from surface, upper air, and tracer chemical sampling networks as well as by aircraft allow the structure, characteristics and morphology of the air and moisture flow of the storm cells to be depicted.

Preliminary analyses show that storms in the midwestern United States assume various complex structures, that trace particulates in the air processed by these storms may reside within the storms for variable periods of time (from approximately 20 min. to 2½ hr.) and that during development urban storms grow much faster than rural storms. This last point implies that the anomalous precipitation maximum located downwind from St. Louis may result from urban storms rapidly attaining sizes large enough for precipitation to initiate.

ESTIMATES OF NORMALIZED ATMOSPHERIC POLLUTANT CONCENTRATIONS AT COME-BY-CHANCE, NEWFOUNDLAND

R. V. Portelli and J. L. Walmsley

The climatology of the Come-By-Chance area of Newfoundland indicates that a high potential for pollution exists there, with the most adverse weather conditions for the dispersion of air pollutants occurring during the month of July. Using Gaussian diffusion models (including the ATDL model (Hanna, 1972)), relative pollutant concentrations have been computed and the results are discussed for the area in light of its climatology.

Session 5 Forecast Research - Part II

FIRST PRECIPITATION FORECASTS FROM THE DPR MODEL ON THE CDC 7600

David Davies and D. W. Shantz

The precipitation scheme in operational use at the Canadian Meteorological Centre is integrated in conjunction with a filtered equations model. A similar scheme is now being developed for use with the DPR primitive equations model. The procedures for predicting large scale precipitation are being adapted in a straightforward manner, but those for predicting small scale precipitation are being redesigned.

An early version of the DPR model containing large scale moisture processes was integrated on the IBM 360 last year. The results revealed a number of problems associated with the vertical motion fields. These are now being investigated.

PROBABILITY OF PRECIPITATION FORECASTS USING CLASSIFIED AND LINEAR PREDICTORS

N. Yacowar

Precipitation probability forecasts are prepared daily at the CMC for a nationwide network of Canadian stations. Among the problems encountered are the choice of a statistical model, specification of precipitation occurrence, the time period of the forecasts and the level of skill required for an operational product. POP forecasts have been transmitted to all field stations for the past year giving the probability of precipitation in the 24 hour period beginning 36 hours after RADAT time.

The perfect prog and Model Output Statistics procedures are examples of the dynamical statistical approach in which regression equations are developed by statistical techniques and applied to the output of dynamical models.

The distribution of frequency of precipitation relative to the range of various predictors was studied. The REEP technique which classifies predictors as 1 or 0 was found to be too sensitive in discriminating between these levels. It was replaced by a procedure which transforms the linear predictors to take on group or class probabilities.

Two thresholds were applied to define the occurrence of precipitation in a 24 hour period. The low level included all precipitation values above a trace. The high level required precipitation above 0.25" (0.10" in the Canadian Prairies).

Verifications were made on the basis of the Brier score. Using reliability tables prepared from previous verifications, modifications were made to subsequent forecasts. The final product, a consensus of the various models used showed significant improvement in verification. Verifications are available for a two year period using the perfect prog equations and for one season using the MOS approach.

ON LEE CYCLOGENESIS AND AIRFLOW IN CANADIAN ROCKY AND EAST ASIAN MOUNTAINS

Yong-S. Chung, Keith D. Hage and Erhard R. Reinelt

A comparative study of cyclogenesis, in the lees of two large-scale mountains, in North America and in Eastern Asia, has been completed. This investigation includes 146 cyclones in the former region and 259 cyclones in the latter mountains. The frequency maxima of lee cyclogenesis in Eastern Asia revealed that cyclones form initially in juxtaposition to major mountain systems. These results agree with a similar analysis of cyclones in Western Canada. The initial formation of most lee cyclones in both regions occurred with the onset of peculiar airflows. They usually commence under a diffluent cross-barrier flow in the mid-troposphere, which is orographically intensified, and superimposed on a zone of orographic descent and low level convergence. On the other hand, appreciable development (or intensification) of a mobile cyclone begins with the approach of an upper cold trough or low. In general this intensification occurs in regions other than the principal cyclogenetic regions. However, these two processes may take place simultaneously at the earlier stage for some intense cyclones.

It was also observed that large-scale topography induces significant orographic modifications in upper airflows. Due to the pronounced effects of vertical motion, horizontal divergence and deflection over these synoptic-scale barriers, it appears that the speed of an airflow does not necessarily increase over the two systems of Cordilleras as other mountain wave studies have indicated. In turn, the compressible flow over large-scale mountains tends to become slower. The

paper concludes with a discussion on the modification of upper cold lows, troughs and jet-streams produced by mountains.

AN ENERGY INDEX FOR THE DIAGNOSIS AND PREDICTION OF SHOWERS AND THUNDERSTORMS

W. S. Harley

A convective storm diagnostic and prediction technique has been developed using equivalent potential temperature to measure the atmospheric instability in terms of the total instability energy available in particular layers. This parameter is combined with other atmospheric instability indicators in an equation measuring the "kinetic energy of unstable motions" potential for the layer.

A development index is obtained combining the above parameter with a number of atmospheric parameters found highly correlated with convective development, viz.: low level moisture, and low and middle level maximum wind. The level of maximum buoyancy and the maximized energy equivalents of the positive and negative areas on an atmospheric sounding above the lifting condensation level at the time of maximum temperature are also used to assess the storm potential both as an index and in combination with other instability parameters.

Automatically computed values of these storm development indicators have been compared statistically with those of indices in common use using ten months of warm season synoptic and radio-sonde data at 72 radio-sonde stations in North America. The optimum combination of convective storm development indicators has been statistically determined and the individual roles of these parameters in the shower and thunderstorm production process are discussed.

Session 6 Plume Studies

BUOYANT PLUME RISE: AN EXAMINATION OF BRIGGS' EQUATIONS

John L. Walmsley

The buoyant plume rise formulae of Briggs (1969) are examined. For certain sets of input data parameters it is expected that the plume rise results will be the same for more than one of the equations. This is not always so. Suggestions for modification to the formulations and their usage are presented.

THERMAL PLUMES IN AN URBAN ENVIRONMENT

D. R. Hay and V. E. Sells

Particulate concentrations in the air above the city of London are being studied with the aid of a pulsed ruby lidar (*Atmosphere*, December 1973). Because of the lidar's vantage point overlooking the city and the collimation of the beam, stack plumes may be located at ranges exceeding 6 km and natural thermal plumes observed at shorter ranges, with positional accuracy of a few meters. Invisible plumes of the latter type occur most commonly in regimes of neutral thermal stability, providing a means of conveying particulate from the surface into the city air during the daytime. Such plumes are observed frequently above roadways; their triggering mechanism and lifetimes are being examined currently.

ON THE BIFURCATION OF BUOYANT PLUMES

F. H. Fanaki

During measurement of the INCO plume rise in the Sudbury area, it was observed that on some occasions the plume split sideways or bifurcated. The bifurcation lasted for a period ranging from a few seconds to a few minutes. During this period the plume behaved like two separate plumes, attached at the source with a relatively clear space in between. The two plumes travelled downwind either on the same horizontal level or on different levels, depending on the meteorological conditions of the area.

In an attempt to describe the initiation of the bifurcation phenomenon, a mathematical model of this phenomenon is presented and supported with field observations.

SOME CONSEQUENCES OF THE PLUME BIFURCATION PHENOMENON IN OCEANIC AND ATMOSPHERIC ENVIRONMENT

M. L. Khandekar and T. S. Murty

In a recent theoretical and experimental study, Hayashi has shown that a buoyant effluent discharged in a fluid medium will develop a bifurcated plume as it becomes bent-over in a cross current and approaches the free surface. The plume bifurcation is initiated as a result of the "image" effect caused by the free surface on the vortex pair which is developed in a bent-over plume.

We have considered, in this study, some consequences of plume bifurcation in oceanic and atmospheric environment. In case of sewage disposal at the bottom of an ocean or for crude oil escaping a grounded tanker, plume bifurcation could contaminate coastal areas. In the atmosphere, bifurcation of a buoyant chimney plume could occur under favourable wind conditions at the location of an elevated inversion that occasionally forms in an urban environment.

Our analysis suggests that recent observations of (sewage) plume bifurcation from an ocean outfall and (chimney) plume bifurcation in an urban environment can be explained using Hayashi's theory. Some implications of our analysis for operational use are considered.

Session 7 Meteorology and the Community

ENVIRONMENTAL IMPACT ASSESSMENT: PRINCIPLES AND PROCEDURES

R. E. Munn

In early February 1974, a two-week Workshop was held at Victoria Harbour, Canada, sponsored by the United Nations, Environment Canada and SCOPE (Scientific Committee on Problems of the Environment). Participants from all parts of the world were given the task of writing a book on environmental impact assessments.

The Workshop will be described, and the main themes contained in the book will be summarized.

URBAN PLANNING UTILIZING A REGIONAL ATMOSPHERIC SIMULATION MODEL
A. E. Boyer

Atmospheric simulation models have grown in size and complexity over the years, ranging from the single source model, to the numerous urban models. The next logical step is the regional model incorporating multiple urban areas. The development of an air quality simulation model extending from Toronto to Hamilton, Ontario and to Buffalo, New York suggests that there is a significant transport of pollutants from one urban area to another within this region. Evaluation of environmental strategies and regional land use planning are, in part, a function of this interurban flow of pollutants.

The spacial gradient of pollutants imposed on one urban area by another are examined in terms of the required grid resolution of the regional model.

The impact of urban areas on one another is found to be most noticeable where transportation facilities or geographic features concentrate industrial land use along straight lines or in corridors.

The impact is increased when corridors of high density land use are parallel to frequently occuring wind directions. On the North shore of Lake Ontario a string of major pollution sources and small cities extend from Hamilton to Toronto along a southwest to northeast line. Peak levels of particulate and SO_2 occur in Hamilton and Toronto with northeast and southwest winds respectively.

Session 8 Atmospheric Electricity - Part I

SURVEY ON THE APPLICABILITY OF ATMOSPHERIC ELECTRICITY
Hans Dolezalek

Invited paper; no abstract available

Session 9 Atmospheric Electricity - Part II

ATMOSPHERIC ELECTRICITY AND THE COMMUNITY
D. R. Lane-Smith, Bhartendu, J. V. Iribarne *et al.*

Atmospheric electrical phenomena, the physical processes concerned and the experimental techniques developed to study them, have important applications in the fields of biology, forestry, air pollution, electrostatics, communications and meteorology.

Various members of the Canadian Committee for Atmospheric Electricity have prepared reports on different aspects of the subject. This paper is an edited compilation of the reports. It attempts to illustrate the need to understand atmospheric electricity and may suggest interdisciplinary areas for future study and development.

THE EQUILIBRIUM CHARGE DISTRIBUTION ON SUB-MICRON AEROSOLS

W. J. Megaw

Freshly generated aerosols frequently contain particles carrying many electronic charges, but as the aerosol ages it approaches a state of dynamic charge equilibrium in which, while the charge state of individual particles is changing continually, the fraction of the particles carrying a specific number of charges, and in particular the fraction which is uncharged, remains constant with time. It can be shown that for a monodisperse aerosol the uncharged fraction is a single-valued function of the particle radius and this has also been demonstrated experimentally. For a heterogeneous aerosol the size distribution can be simply derived provided its general form is assumed. This paper describes work in which the size distribution as derived by the equilibrium charge method is compared with that found by direct measurement of the size distribution of samples.

POSITIVE AND NEGATIVE ION MOBILITY SPECTRA OF SPRAY PRODUCED IONS

B. A. Thomson and J. V. Iribarne

The production of ions by evaporation of aqueous droplets may throw light on the properties of atmospheric ions and has importance as an atmospheric process.

The positive and negative mobility spectra of ions remaining after atomized water or solution droplets have evaporated were measured under a variety of conditions including different humidities, solution conductivities and ionic ages. A four grid apparatus was used, consisting of two electronic gates enclosing a drift space, the gates being opened and closed by a variable-duty-cycle pulse-generator. Ions were introduced into the tube by an electric field perpendicular to the plume of spray, and the ion current at each pulse frequency was measured to obtain the mobility spectrum. Good resolution was obtained, enabling peaks differing in mobility by only 5% to be separated. The mobilities were measured in a controlled atmosphere produced by a slow flow of dried and purified air through the measuring and aging sections.

The striking feature in the results is that the majority of negative ions have a unique (reduced) mobility of 1.77×10^{-4} m^2/Vs with a small peak present at 1.08×10^{-4}, while the positive ions are contained in two rather broad peaks (which merge) at 1.13 and 0.95×10^{-4} (the latter being the dominant one) and a small peak at 0.3×10^{-4}. The large difference between positive and negative ion mobilities, corresponding to a mass difference of more than 300 amu, suggests a fundamental difference in their evolution. The addition of NaCl produces a new peak at 0.76×10^{-4} m^2/Vs for positive ions, and concentrations of more than 10^{-3} M largely deplete the fast ions of both signs. Increasing the ion age generally shifts the ions to the higher mobility peaks. Increasing the relative humidity of the air to 80% has little effect upon the positive ions but causes the appearance of a peak at 1.55×10^{-4} m^2/Vs for negative ions which is dominant for the shortest age. Our setup has improved resolution and overall control of conditions as compared with that of Chapman (1937, 1938), who obtained somewhat different results with an Erikson tube.

Comparative measurements of the number of condensation nuclei left by the evaporated spray with a General Electric counter showed a slow increase with concentration of NaCl. Increasing the net electrical charge carried by the spray produces an increase in ions, but not in condensation nuclei.

The results are interpretable in terms of the separation of ions from the original multiply charged drops, and the later evolution of the ions, particularly with regard to the sign.

ARE METEOROLOGICAL VARIABLES RELATED TO ATMOSPHERIC ELECTRICITY PARAMETERS?

R. G. Lawford and Bhartendu

Complete measurements of meteorological and atmospheric electricity parameters have been collected at Woodbridge, Ontario since 1969. The data for 1969 and 1970 have been analyzed and the results are presented in this paper. In particular the relationships between Ohm's law parameters and temperature, mixing ratio and pressure are discussed. Other interactions between atmospheric electricity parameters and synoptic fields will be demonstrated. These results are then compared to measurements made by other investigators and the relationships expected on the basis of current atmospheric electricity theories. One result which demonstrates the strong interactions between meteorological and fair-weather atmospheric electricity parameters indicates that potential gradients are very sensitive to changes in the phase of water substance.

Session 10 Dynamical Meteorology - Part I

THE INFLUENCE OF OROGRAPHY AND SURFACE FRICTION ON SYNOPTIC SCALE VERTICAL MOTION OVER WESTERN CANADA

Gary R. Schram and M. L. Khandekar

In this diagnostic study, an analysis of the three dimensional vertical motion fields associated with some selected synoptic situations over western Canada is made. A four-level model is formulated to obtain the vertical velocity fields by solution of the quasi-geostrophic omega equation. A grid encompassing western Canada including as well parts of the Northwest Territories, Alaska, the eastern Pacific Ocean and a small part of northwest United States is used with a horizontal grid distance of 200 km in the x and y directions. The synoptic situations have been chosen so as to portray the influence of the western cordillera of North America with particular emphasis on the initiation and development of the lee cyclones over Alberta and the Northwest Territories.

With the help of topographic charts, surface elevations at each grid point are carefully evaluated. The drag coefficient at each grid point is determined by objectively interpolating Cressman's data over North America. Special consideration is given to the inadequate data network, especially over the Northwest Territories, Yukon and a large part of the eastern Pacific Ocean. Data from Lark Juliet flights are included to get adequate coverage over the Pacific Ocean, while hypothetical upper air data have been generated over several surface stations using climatological as well as observed surface values. This enables us to improve considerably the accuracy to which grid point data can be derived using an objective analysis scheme.

The influence of orography and surface friction, as well as the effect of differential friction on vertical velocity fields, are carefully evaluated by suitably changing the lower boundary conditions. These results are discussed and their implications for developing a suitable prediction model for weather systems over western Canada are considered.

THE ADJUSTMENT OF THE WIND FIELD TO SMALL SCALE TOPOGRAPHY IN A NUMERICAL WEATHER PREDICTION MODEL

H. Allard and J. Derome

The primitive equation model developed at the Dynamic Prediction Research Division of the AES is used to produce a 20 hour forecast over the Northern Hemisphere with the standard horizontal grid length (381 km at 60°N). The forecast is then interpolated to a higher-resolution grid covering the northeastern part of America and the forecast is continued for a further period of four hours over that area. The forecast from 20 to 24 hours is performed with a version of the model with sufficient horizontal resolution to reproduce topographical features such as the St. Lawrence and Richelieu Valleys. The 24 hour high-resolution forecast is then compared with the usual, lower-resolution 24 hour forecast. The comparison reveals how the horizontal and vertical wind-fields are affected by the small-scale topography. In particular, the channelling effect of the St. Lawrence and Richelieu Valleys is clearly demonstrated.

ON THE ORIGIN OF MOUNTAIN-ASSOCIATED WAVES IN WESTERN NORTH-AMERICA

E. R. Reinelt and D. Oracheski

An interesting class of infrasonic signals, tentatively named "mountain-associated waves", has been observed in the past several years by a network of infrasonic observatories, including one at Edson, Alberta. These waves propagate at acoustic velocities over distances of several thousand kilometers, because of the low sonic-attenuation characteristic of waves with oscillation periods in the 10-100 second range. Some types of infrasonic signals have been identified with jet-stream turbulence and auroral activity, but many others appear to be closely associated with prominent orographical features. A high proportion of the waves received at Edson originate in the Stikine Mountains, and the principal chain of the Rockies in Northern British Columbia. Most of these waves occur with strong westerly winds, although a few signals are received from source regions with light and variable winds.

A DIAGNOSTIC STUDY OF AN INTENSE MESOSCALE DISTURBANCE IN THE BOMEX AREA

S. M. Daggupaty, C. L. Smith, E. J. Zipser and L. Sapp

A mesoscale disturbance whose life span was about 12 hours intially formed, developed into its peak activity and decayed within the BOMEX network on 26 July 1969. This particular case study deals with its phase of intense activity. The mesoscale disturbance was enclosed in the trough region of a large scale wave in the easterlies. The BOMEX network with research aircraft flights provided the critical small-scale data that permitted mesoscale analyses to be performed. The study region in the horizontal extends from 8N to 18N and 54W to 64W and in the vertical it extends from 1000 to 200 mbs. The grid interval used for various diagnostic computations is 1/3 of a degree in the horizontal and 50 mbs in the vertical.

Kinematic vertical velocity is computed utilizing the technique of O'Brien and Fankhauser. The computed vertical velocity pattern is very well correlated with the Barbados Island radar echo distribution. Vorticity and energy budgets revealed important differences in the characteristics of the mesoscale disturbance from the usual wave phenomena in the tropical easterlies of the Atlantic.

THE ATMOSPHERIC ENERGY BUDGET OF THE HEMISPHERES

G. J. Boer

The concept of available potential energy is a global one, implying that energy budget studies using this concept must also be global in extent. It is possible however to treat, in various ways, the "contribution" of a restricted region to the global energy cycle. We use a method which differs from the usual procedure based on the Lorenz approximations to the zonal and eddy forms of the energy equation. The method is based on the exact equations in pressure coordinates and leads to a new set of zonal and eddy forms of the energy equations in pressure coordinates. When applied to restricted regions of the atmosphere, terms arise representing the transport of various forms of energy across the boundaries of the region.

The equations are applied to long-term general circulation data for the two hemispheres and it is shown that important transequatorial transports of energy are a feature of the hemispheric energy budgets.

Session 11 Atmospheric Electricity - Part III

PERTURBATION OF ATMOSPHERIC ELECTRIC PROCESSES DURING AN ECLIPSE

D. R. Lane-Smith and R. Markson

An observing station was set up near Malignant Cove, Nova Scotia, close to the centre line of the July 10, 1972 eclipse. Totality lasted about 2½ minutes.

Measurements were made of potential at 1 m with a fast response probe and magnetic recording, positive and negative conductivity, air-earth current, potentials at 25 cm, 1 m, 2.5 m and 6 m and space charge. Also monitored were solar radiation, wind speed and direction.

The phenomena of fair weather electricity may be better understood when the results of perturbations to fair weather conditions are observed. A total eclipse of the sun offers a perturbation which is large, widespread and rapid.

The vertical probe array showed nearly simultaneous perturbations of potential dropping to a minimum of about 35% of normal fair weather potential at 45 mins after totality. Except at this minimum, there were superimposed on the slow potential changes, small simultaneous maxima indicating the close approach of a vertical column of space charge such as generated by a thermal plume. These maxima occurred at about half hour intervals.

The fast response probe showed a dramatic change in the spectrum after the eclipse. There was a progressive attenuation of the higher frequencies during the 30 mins after totality and then a sudden reversion to the pre-eclipse spectrum.

The measurements of conductivity, air-earth current and space charge also showed interesting changes which are consistent with an overall pattern of events.

It is clear that during the eclipse thermal convection is inhibited. As a result turbulence dies away and the exchange layer ceases to exchange. The area covered by the eclipse may be considered as a moving region of inhibited air motion. Ions are free to move under the influence of electric fields without being transported by the air. The effective conductivity of the air therefore rises. The whole set of data may be explained in these terms and may then be analysed quantitatively.

THE ELECTRIFICATION AND FRAGMENTATION OF FREEZING DROPS

R. J. Kolomeychuk, J. V. Iribarne and D. C. McKay

The electrification and fragmentation of freezing drops, freely suspended in a nitrogen gas stream, was studied. Ninety percent of the freezing drops (1.7 mm average diameter) shattered or cracked. This behaviour can be attributed to the build-up of internal pressures due to the formation of a rigid spherical ice shell favoured by a symmetric heat transfer. The average charge separation per drop breaking or cracking was -0.1×10^{-3} esu for water, -0.2×10^{-3} esu for 10^{-4} M $(NH_4)_2SO_4$ solution, and $+0.035 \times 10^{-3}$ esu for 10^{-4} M NaCl solution. Statistically, these results were not significantly different from 0, except for the $(NH_4)_2SO_4$ solution, which was definitely negative. Neither the electric double layer theory nor the temperature gradient theory can account for the observed charge separations. However, it is possible that the electrification might be attributed to either the fracturing or cracking of the drop assymmetrically separating electrical charge or to the friction of separating ice. Sixty percent of the drops frozen in an ice saturated nitrogen gas stream cracked or broke. Ice splinters were ejected in these cases, in various amounts ranging from 0 to over 100. The average number per frozen drop was 35, referred to broken or cracked drops, or 18 referred to all drops. These numbers may possibly explain the abnormally high concentrations of ice crystals observed in certain types of cumulus clouds.

ELECTROSTATIC METHODS FOR REMOTE SENSING OF PLUMES

W. L. Boeck and B. Vonnegut

Plume detection and tracing has been accomplished by passively sensing electrostatic "emissions" at the low frequency end of the electromagnetic spectrum. A space charge plume, consisting of charged aerosol particles with an excess charge of one polarity, has a Coulomb electrostatic field which perturbs the atmospheric electrical field. The earth's fair weather atmospheric electrical field is the result of excess negative charge on the surface of the earth and a slight excess of positive ion density in the atmosphere. The field perturbation is concentrated beneath the charge plume because the space charge gives rise to an additional induced "image" charge on the surface of the earth under the plume. It is not widely known that various industrial processes exhaust charged aerosols to the atmosphere. The highly charged fine particles which escape collection in an electrostatic precipitator produce a particularly intense negative space charge plume. Field measurements show that such a space charge plume will produce a band of reversed polarity atmospheric electrical field on the earth's surface that extends several kilometers downwind from the plume source. An electrostatic field mill, mounted on the roof of a van, has been used to make mobile electrostatic surveys in the Niagara area. Examples of the electric field perturbations produced by the precipitators of a coal-fired electrical generating station as well as by the natural space charge plume produced by the falls at Niagara shall be given. Other industrial sources of space charge will be noted. Since electric charge is not considered a pollutant, the use of atmospheric ions as air motion tracers should not raise environmental objections. Electrostatic methods should be included with techniques for remote sensing, particularly where rugged, low cost methods not severely limited by darkness, poor visibility or cloud cover are needed.

THE RADIOACTIVE SOURCE AS A POTENTIAL PROBE

D. R. Lane-Smith

For many years, α particle sources have been used to equalize the potential of a wire above the ground with the air at that point and so provide a measure of the vertical potential gradient. However, while various 'equivalent circuits' have been published, the author has not found any which are based on the basic physics involved or which cover all the conditions under which measurements may be made.

An expression is derived, on theoretical grounds, for the probe current in terms of the driving voltage and various other parameters. The expression is compared with experimental measurements made over a wide range of operating conditions. Methods of calculating error correcting factors are discussed.

In most set-ups, radioactive probes have response times of the order of seconds. A method is presented of reducing this response time to the order of a millisecond.

It is known that radioactive probes perturb other electric parameters. The extent of this perturbation is calculated.

Session 12 Dynamical Meteorology - Part II

MODELLING OF THE STATIONARY PLANETARY WAVES IN THE STRATOSPHERE

C. Beaudoin and J. Derome

The standing planetary waves have been modelled by means of a quasi-geostrophic linear model including the full variation of the Coriolis parameter in spherical geometry. The structure of the standing waves was assumed known at 500 mb and the structure in the stratosphere was obtained as a solution of the model equations. Some tests were made to determine the sensitivity of the results to the boundary condition assumed at the top of the model. In some cases the vertical velocity was assumed to vanish at the top of the model while in others a radiation condition was used to allow the wave energy to escape to the upper atmosphere. It was found that when the upper boundary of the model is located at 65 km both boundary conditions yield similar results for the wave structure. When the upper boundary is lowered, however, the radiation condition leads to far better results. The effect of the vertical resolution on the wave structure was also investigated. The results indicate that a reduction in the vertical resolution leads to a reduction of the wave amplitude. Finally, it was found that, given a model with a small number of levels in the vertical, a better modelling of the wave structure in the lower stratosphere was achieved when these levels were spread over a deep atmospheric layer than when they were concentrated between 5 and 22 km.

THE GREEN FLASH AND CLEAR AIR TURBULENCE

Alistair B. Fraser

There has long been speculation about why the green flash can be seen on one day, while on another apparently similar day it cannot. Theory, however, requires that when it is seen over irregular terrain that the necessary atmospheric refractive structure must have horizontal inhomogeneities. A combination of extensive observations of the green flash and a simple model of its formation suggests that it is usually formed by refraction through gravity waves which have wavelengths between 200 and 1000 meters. In the atmosphere such waves

derive their energy from wind shear and are the same waves that are associated with clear air turbulence. This model not only explains the frequent observations of multiple green flashes, but also, by demonstrating a dependence on atmospheric dynamics, it accounts for the variability in the occurrence of the green flash on otherwise comparable days.

SUB-GRIDSCALE TURBULENCE
Philip E. Merilees

Ideally, any numerical model of the atmosphere should have its minimum resolvable wavelength well into the viscous dissipation range. Since viscous dissipation takes place on the scale of a centimetre whereas the largest scales of global variation are of the order of 4×10^9 cm, it is practically impossible to treat this range of scales explicitly. Fortunately, it is also unnecessary for many purposes associated with numerical weather prediction. Nevertheless, if the minimum resolvable scale in the model is greater than the viscous scale, we are immediately faced with the problem of accounting for at least the statistical effect of those scales dropped on those retained, much like a coefficient of viscosity is a statistical effect of molecular motions.

It is believed, at least for the extent of determinism on the large scales, that the sub-gridscale turbulence acts as a dissipator of energy and enstrophy. Indeed, most parameterizations of sub-gridscale turbulence are based on this idea and the resulting "eddy viscosity". From a practical point of view, such a dissipative mechanism is absolutely necessary for most finite-difference models because they will become computationally unstable without it. Complete spectral models without a dissipative mechanism do not become computationally unstable, but exhibit other forms of non-physical behaviour. While so-called "eddy viscosity" formulations do prevent computational instability and do produce some realistic effects, they are by and large *ad hoc* in the choice of adjustable parameters and also produce some undesirable side effects.

The above problems are explored through a series of numerical experiments. The traditional method of numerical smoothing is rediscovered as a more useful and practical approach to turbulence parameterization.

INTERACTION BETWEEN GRAVITY WAVES AND BASIC FLOW
M. Shabbar

Some relations between Reynolds stresses, energy density and group velocities associated with atmospheric gravity waves are derived and the energy exchange mechanism between waves and the basic flow is explained from a different viewpoint.

FOURIER TECHNIQUES ON THE GLOBE
G. J. Boer and L. Steinberg

A method of representing atmospheric parameters on the globe in terms of two-dimensional Fourier series has been devised. Non-aliased spectral calculations using this representation are performed using the transform methods of Orzag which are based on the FFT. It is hoped that these methods will be suitable for integrations of the equations of motion. Preliminary tests involving the passive advection of a conical shape on the sphere are described.

AN INTERVALOMETER FOR SFERICS DIRECTION FINDING AT 73.6 MHZ

Donald C. Scouten and David T. Stephenson

This paper describes the design considerations involved in a new instrument for sferics direction finding now being developed by the Engineering Research Institute at Iowa State University.

Direction finding has been primarily used to find the geographical location of sferic sources and most of the equipment used to date has been designed to operate below 1 MHz. We believe that two dimensional direction finding (azimuth and elevation) can be an effective tool in the study of the nature of atmospheric discharges and may lead to the positive identification of certain types of weather events by their sferic characteristics (high energy atmospheric vortices may emit sferics, for instance, and could be recognized by their shape). We note in particular the excellent study of Proctor with hyperbolic position fixing equipment where he was able to show the time progression of a single lightning stroke through several phases of charging from above and discharging to the ground.

The VHF portion of the radio spectrum appears to have the most utility for high performance two dimensional direction finding. Lower frequencies would require large physical installations. At higher frequencies the signal strength from sferic sources is sufficiently weak that only nearby storms could be studied. The 73.0 to 74.6 MHz radio astronomy band seems to be ideal for sferics work and we have chosen a center frequency of 73.6 MHz for our studies. The disadvantage of working in the VHF region is that powerful TV stations are an ever present source of interference. The 73.6 MHz frequency is bounded by CH4 (66-72 MHz) and by the air traffic control at 75 MHz. The utility of wide bandwidth direction finders such as the system described by Cianos, Oetzel, and Pierce may be limited by this interference problem except in very isolated areas. Therefore, we have chosen to limit the bandwidth of the receivers to be well within the radio astronomy band.

The other major design criterion is that an intervalometer type of direction finder must resolve time intervals considerably less than 1 ns if the antenna spacing is not to be too large (in our case about 7 m). The two major design criteria (narrow bandwidth and good time interval resolutions) conflict but they can complement each other if resonators of extreme stability are available. The heart of our system is a receiver whose response is dominated by a coaxial resonator tuned to 73.6 MHz with a Q of about 400. An incoming sferic impulse is converted into a damped sinusoid (RF) at 73.6 MHz which can then be converted to a lower frequency (IF) sinusoid (.736 MHz) by a conventional superhetrodyne process. The zero crossings of the IF sinusoid are delayed by a time factor which is the ratio of the two frequencies (RF to IF = 100 in our case). Thus, the time interval between two signals may be measured at the IF level with a time expansion that is typically 100 to 1. Conventional scalers may be easily fabricated with resolutions on the order of ± 5 ns so that effective time resolutions of ± 0.05 ns are theoretically possible but noise in the zero crossing measurement causes the practical limit to be on the order of ± 0.2 ns.

Our system will include three such receivers connected to three antennas located at the vertices of an equilateral triangle so that three time intervals may be measured for each incoming sferic. Only two time interval measurements are necessary to calculate the azimuth and elevation angles so there is some redundancy in the measurement.

IMPROVED RADIO-LOCATION OF LIGHTNING
James Percey and E. J. Stansbury

When the radio signal from a lightning flash is recorded against time, it is bound to be made up of a number of irregularly spaced strokes. There is enough variety among flashes that the trace against time may be used as a signature to identify the same flash at two or three stations separated by tens of kilometres. On a good cathode-ray direction finder, a radial trace is recorded which gives the direction of the lightning from the station, but which hides the signature in its single line. We have rebuilt our direction finder, causing the no-signal location of the spot to move in a coarse rectangular raster. Thus the single radial line for each flash is replaced by a few parallel lines, one for each stroke. This restores the characteristic signature, and the capability of identifying the same stroke at the two or three stations involved in triangulation. Two summers' use has demonstrated this capability which, combined with the resolution of direction achieved already, is enabling us to associate radio-observed lightning with radar-observed precipitation cells.

VARIATION OF VLF SPECTRA WITH RANGE FOR LIGHTNING SFERICS FROM SOURCES AT INTERMEDIATE RANGES
W. D. MacClement and R. C. Murty

Very Low Frequency spectra for frequencies between 1kHz and 20kHz have been obtained for sferics from lightning occurring at various ranges between 5 and 200 miles. Range has been estimated using both the weather radar data and the University of Western Ontario VHF Sferics Direction Finder.

Sferics were recorded from storms in different directions at different times. The averaged spectra appear to indicate that the attenuation of frequencies both above and below the energy peak increases more rapidly with range than the attenuation of the peak itself. Preliminary analysis also shows negligible differences either due to the direction of the sources or the time of occurrence.

ELECTRICAL PROCESSES AND THUNDER GENERATION
Bhartendu

Shock wave theories have been unable to explain the infrasonic component of thunder spectra and recently theories based on electrical processes have been advanced to explain it. The validity of these theories will be examined in light of thunder measurements made at Toronto on power spectrum, sound pressure level and the nature of pressure variations.

Session 14 Dynamical Meteorology - Part III

A ZONALLY AVERAGED CIRCULATION MODEL OF THE STRATOSPHERE INCORPORATING RADIATIVE HEATING AND OZONE PHOTOCHEMISTRY IN AN OXYGEN-HYDROGEN-NITROGEN ATMOSPHERE
R. K. Rao-Vupputuri

In the stratosphere, ozone, HO_x, N_2O and NO_x are not only interdependent among themselves, they are in turn coupled to the raidative and transport properties of the stratosphere. In view of these non-linear effects it is more

appropriate to solve the continuity equations for ozone, HO_x, N_2O and NO_x simultaneously in a transport model.

In this study a zonally-averaged model of the stratosphere incorporating the mutual interactions among ozone, HO_x, N_2O, NO_x, temperature and the mean circulation was developed under steady state assumptions. The model was an extension of the two dimensional steady state model developed previously for the photochemical scheme of oxygen-only atmosphere.

Using the classical photochemical scheme along with new rate coefficients in the first experiment it was shown that the computed distribution of ozone is quite unrealistic as compared to the observations. However, by incorporating the additional reactions involving hydrogen and nitrogen compounds, a satisfactory agreement was achieved between the computed ozone distribution and the observations.

Consistent with the computed distribution of ozone, the meridional distributions of HO_x (H0 and HO_2) N_2O, NO_x (N0, NO_2 and HNO_3), temperature and the mean circulation were also derived for the summer and winter seasons. The results show that the computed distributions are in general agreement with the available observations.

The sensitivity tests show that a 100% increase in the mixing ratio of water vapour has the effect of reducing the total ozone by only 2 to 4% with highest percentage changes occurring in the high-latitude summer. On the other hand a 100% increase in the NO_x source strength contributed to the total ozone reduction between 10 and 16%, again the greatest percentage changes taking place in the summer high latitudes.

A PARAMETERIZED MODEL FOR THE CALCULATION OF LONG-WAVE RADIATIVE FLUXES IN THE ATMOSPHERE

S. F. Woronko

An efficient parameterized model has been developed for the calculation of atmospheric fluxes due to water vapour, carbon dioxide, and ozone, for altitudes up to 70 km. This model has been derived from detailed calculations which incorporated the effects of Lorentz and Doppler broadening of spectral lines using a formulation that permits more accurate treatment of non-homogeneous paths than is possible with scaling approximations. Clouds and aerosols are treated as 'grey' absorbers.

The parameterization takes advantage of the statistically dominant features of the absorber profiles in the atmosphere by relying on the expansion of the profiles into linear sums of empirical orthogonal components. It is very efficient because the fluxes are calculated directly from the coefficients of the expansion.

A DIAGNOSTIC STUDY ON THE EVOLUTION OF AN INTENSE TROPICAL MONSOON DEPRESSION

S. M. Daggupaty and D. R. Sikka

A tropical vortex in the southwest monsoon season formed in the Bay of Bengal on 2 August 1968 and intensified into a depression while moving westwards. The depression reached its peak activity on 6 August. During this period the observed heavy rainfall region was always in the western sector of the depression. The evolution of the depression is studied diagnostically using a non-linear Balance model. A simple scheme of convective parameterization is utilized in

the model. The asymmetric character of the rainfall distribution is explained with the help of the computed vertical velocity pattern from the numerical model. The vorticity budget over this period of intensification clearly brings out that the westward movement of the depression is largely due to the convergence effect rather than the usual horizontal advection of vorticity.

BOUNDS ON SOLUTIONS TO NONLINEAR REACTION-DIFFUSION EQUATIONS

F. J. Testa

By applying a general theorem on nonlinear parabolic equations, we present sufficient conditions for obtaining bounds of the form $u_{\pm}(x, t)$ on solutions to nonlinear reaction-diffusion equations of the form

$$\frac{\partial u}{\partial t} - a_{ij}(x, t)\frac{\partial^2 u}{\partial x_i \partial x_j} - b_i(x, t)\frac{\partial u}{\partial x_i} - A(u, t) = f(x, t).$$

Such equations are relevant to important problems in atmospheric chemistry and air pollution. In addition, we note that the sufficient conditions for obtaining bounds may often be satisfied by a suitable choice of the disposable functions in the theory. Furthermore, the bounds thus obtained are expressed in terms of solutions to an ordinary differential equation and a linear partial differential equation and therefore often admit quadrature or analytic representations. The accuracy of the bounds for small and large t is discussed. A specific example is also considered.

Session 15 Rain, Hail and Fog

ICE FOG AT ARCTIC AIRPORTS

R. G. Lawford, M. O. Berry and I. Savdie

The occurrence of ice fog in Northern Canada is characterised by diurnal and seasonal variations which differ markedly from one location to another. In order to document these variations 20 years of hourly weather observations have been analyzed for a number of Arctic stations.

The results demonstrate the existence of large year-to-year variations and for some locations an increasing trend in the annual number of occurrences. After the diurnal variations are shown, the relationships between the occurrence of ice fog and meteorological variables such as temperature and wind direction are demonstrated. The role of local topography and other possible causitive factors in the occurrence of ice fog are also discussed for several locations.

THE OBJECTIVE MEASUREMENT OF ALBERTA HAIL

G. S. Strong and E. P. Lozowski

Two networks of calibrated hailpads (styrofoam squares covered with aluminium foil) were set up in conjunction with Alberta Hail Studies' PROJECT HAILSTOP 1973, in order to evaluate their usefulness for objectively measuring hailfall parameters. A total of 272 stations were maintained by farmer volunteers,

with an average station density of .07 km^{-2}. Seventeen hailswaths passed over one or both networks, yielding data on hailstone size distributions, impact energy, momentum, and mass. This data can be compared with crop damage estimates. Results from at least two major storms will be presented.

Two concentrated networks with hailpad density of 10 km^{-2} were also established in order to test the areal representativeness of a single hailpad. These demonstrated the existence of small-scale spatial variations in the hailfall from two storms. This evidence for a fine scale structure within the hailfall has important implications for the design of a measuring network to evaluate hail suppression experiments. Other limitations and advantages of the hailpad will be discussed.

RADAR ANALYSIS OF FLASH FLOOD PRODUCING STORMS

G. L. Austin and Lydia B. Austin

Radar analysis of storms producing flash floods in the City of Ottawa and rural Quebec leads to the conclusion that geometrical factors including speed of motion and direction of elongation compared with direction of motion were much more important than the storm intensities.

COLLECTION EFFICIENCIES OF ARTIFICIAL HAILSTONES

Ron Stewart and Roland List

A series of experiments on the growth of artificial oblate spheroidal hailstones (diameters 2 and 3 cm, axis ratios 0.5, 0.67, and 1.0) was conducted at the Swiss Federal Snow and Avalanche Research Institute in 1972. In these experiments the temperature was varied from -5 to -30^{0}C and the liquid water content from 2-40 gm/m^3. The free-fall behaviour of the hailstones was assumed to be represented by the ice particles having no rotation, rotation about the major axis, rotation about the minor axis, or symmetric gyration.

The collection efficiences of the hailstones were measured as functions of the liquid water content, particle shape and size, and the air temperature for the different aerodynamic situations. They varied typically between 15-55%. A mathematical regression on these results was then carried out to quantitatively determine contributions of the different environmental conditions. Variation of the liquid water content had the largest effect on the collection efficiency, followed by the effect due to air temperature.

SEVERE LOCAL STORMS IN SOUTHERN SASKATCHEWAN - 27 AUGUST 1973

Alexander H. Paul

Some of the largest hailstones ever recorded in Canada fell in southeastern Saskatchewan on 27 August 1973. Severe thunderstorms affected much of this region and extended into Manitoba; they resulted in one death and damage to crops and property amounting to millions of dollars. In Yorkton alone damage was estimated at $3,000,000. The widespread storms served to emphasise the fact that severe hail losses occur through the whole prairie region, although research into the problem has been concentrated in Alberta.

The hailstones, 4½ inches (114 mm) across, that fell near Cedoux, Saskatchewan attracted a great deal of public attention and guaranteed excellent response to interviews and surveys of the extent of the storms. This paper gives

a general account of the storm system and reports more detailed studies by the Saskatchewan Hail Research Project (SHARP) in the Regina-Moose Jaw area. Further work on the storms was carried out by the Regina Weather Office in the Yorkton-Melville-Fort Qu'Appelle area. In addition Dr. E. Lozowski, University of Alberta, collected samples of the giant hail for laboratory analysis and gathered information on conditions experienced in the Cedoux area.

The results of the survey carried out by SHARP on the 27 August storm which swept through its project area are presented here. Some similarities to Alberta hailswaths were evident, although the overall synoptic situation showed differences from that commonly associated with major hail days in Alberta.

It is anticipated that besides amassing climatological data on hail in the next several years, SHARP will undertake further detailed storm studies in southern Saskatchewan. The resulting data will provide a valuable base for comparing Saskatchewan hailstorms with the better-documented storms of Alberta.

Session 16 Micrometeorology - Part 1

LOG-LINEAR WIND AND TEMPERATURE PROFILES OVER A ROUGH TERRAIN DURING INVERSION CONDITIONS

S. SethuRaman and R. M. Brown

Mean wind and temperature profiles measured at six heights up to 126 m above the ground surface during inversion conditions at Brookhaven National Laboratory, Long Island, U.S.A. have been analyzed to study their variation with height. The terrain around the meteorological tower is uniformly rough. Displacement height due to the presence of this rough terrain has been taken into account in the analysis.

Hourly averaged wind speeds and temperatures in the range $0.1 < \frac{Z}{L} < 100$ are found to obey the log-linear law where Z is height above the ground and L is Monin-Obukhov's length. This corresponded to flux Richardson numbers varying from 0.03 to 1.3. Monin-Obukhov coefficient α is found to decrease with increasing Z/L from about 5 at Z/L equal to 0.1 reaching an asymptotic value of 0.6 (originally suggested by Monin and Obukhov) at Z/L equal to 10. In the transition range between Z/L of 0.1 and 10, α is found to be a function of Z/L.

THE NOCTURNAL INVERSION: A THEROETICAL VIEW

Yves Delage

Th evolution of the nocturnal inversion is studied in relation to the wind profile and the intensity of turbulent transfer. It is shown how the coriolis parameter is an important time scale for the development of the inversion. The depth of the inversion is quantitatively related to external constraints, such as the rate of cooling of the ground surface and the geostrophic wind. The results are obtained through the time integration of a one-dimensional numerical model involving the wind, temperature and turbulent energy as a dependant variables.

A SPECTRUM OF MESO-SCALE TURBULENCE
Bryan R. Kerman

A dimensional analysis of the turbulent kinetic energy and enstrophy conversions within the meso-scale region of the atmosphere is outlined. A similarity solution is derived which asymptotically matches the spectral fluxes of energy and enstrophy in the adjacent enstrophy and energy sub-ranges. The resulting energy spectrum possesses a spectral gap, at a critical wavenumber, for flows in which the vertical shear dominates the two-dimensional vorticity of the geostrophic scale.

GENERATION OF TEMPERATURE FLUCTUATIONS BY STATIC PRESSURE FLUCTUATIONS IN THE ATMOSPHERIC BOUNDARY LAYER
Carl A. Friehe

An estimate of the temperature fluctuations that can be generated by turbulent static-pressure fluctuations is made assuming an adiabatic temperature-pressure relationship. The turbulent static pressure data of Elliott obtained in the atmospheric boundary layer is used to calculate root-mean-square temperature levels and power spectra. The results indicate that the pressure-generated temperature fluctuations are lower than those commonly measured in open ocean conditions. The pressure data of Elliott obtained over waves indicates that for high wind conditions there may be appreciable generation of temperature fluctuations at the wave swell frequency.

FLUX MEASUREMENTS ON LAKE SIMCOE
H. C. Martin

A set of measurements were made this spring on the ice of Lake Simcoe. Thirty-minute mean values of sensible and latent heat flux, stress and net radiation were determined. The rate of heat gain by the ice surface was calculated. In addition, mean wind speed, temperature, and vapour pressure were measured at several levels. This preliminary study provided the first evaluation of a portable flux-measuring system recently developed in this laboratory.

Session 17 Remote Sensing - Part I

LIDAR POLARIZATION ANALYSIS OF THE LOWER TROPOSPHERE
J. D. Houston, S. R. Pal and A. I. Carswell

The polarization properties of the backscattering of a lidar pulse from the lower atmosphere have been measured using a pulsed ruby lidar with four independent receiving channels. Each channel contains polarization analysis optics so that the complete Stokes vector of the backscattered signal can be measured with one observation. The total intensity, depolarization ratio, rotation angle, ellipticity and handedness of the received signal are calculated from the measured Stokes vector components. These parameters are shown to exhibit markedly different behaviour under differing meteorological conditions.

The lidar system operates at the doubled ruby wavelength (347.2 nm) as well as at the fundamental (694.3 nm). The first two Stokes vector components have been measured at both wavelengths simultaneously. The depolarization ratios

obtained for the two wavelengths yield information on the relative concentrations of Rayleigh, Mie, and non-Mie scatterers in the atmosphere.

Both the Stokes and two-wavelength measurements have been made for scattering media ranging from clear air to clouds. A summary of these results will be presented.

SPECTROPHOTOMETRIC MEASUREMENTS OF ATMOSPHERIC NITROGEN DIOXIDE

A. W. Brewer, J. B. Kerr and C. T. McElroy

Nitrogen dioxide and its related compounds react strongly with ozone, usually resulting in the destruction of ozone, and life seems to be delicately adjusted to the radiation shield which the stratospheric ozone provides. The proposed commercial supersonic aircraft will emit oxides of nitrogen at levels within the ozone layers, thereby threatening the stability of the protective ozone shield. Because of the current uncertainty of the concentration of the photochemically active oxides of nitrogen in the stratosphere, we have established a program to measure the vertical profile of atmospheric nitrogen dioxide. Spectrographic measurements of NO_2 have been made from both the ground and from aircraft, including measurements made from on board the british prototype Concorde 002 during environmental flights which were flown in October and November, 1973. The results of our NO_2 measurements as well as their significance will be presented.

FIELD TESTS OF A MICHELSON INTERFEROMETER

W. A. Gault

A small Michelson interferometer has been built for remote sensing field applications. It measures the spectrum in the visible and near infrared at low to moderate resolving power. The large throughput allows the possibility of rapid scanning and image dissection. In a recent test flight in a DC-3, the instrument performed extremely well. This and other tests of the interferometer will be described.

LIDAR BACKSCATTERING FROM CIRRUS CLOUDS AND INVERSION LAYERS

S. R. Pal, J. D. Houston and A. I. Carswell

The transfer of solar radiation in the Earth's atmosphere is significantly modified in the presence of cirrus clouds and this affects the atmospheric heat balance. The radiative transfer characteristics of these clouds are not well known. Investigation of these characteristics is difficult because of the fact that the supercooled particle ensembles in cirrus are rather complicated. Dominantly present ice crystals of arbitrary shape and size, are mixed with spherical droplets which have a distribution of sizes.

Some of the properties of cirrus clouds can be studied with a pulsed laser radar capable of producing a polarized radiation and such observations are presented in this paper. Lidar pulse penetration of up to several kilometers in these clouds is possible and the returns show distinct structures in the polarization. The extinction and multiple scattering effects in cirrus clouds will be discussed in relation to the measurements on low level cumulus clouds wherein the Mie particle phase generally dominates.

In addition, some lidar observations of inversion layers will be presented.

The short-term fluctuations in the height and the density of inversion layers have been observed. These variations are found to affect the backscatter polarization of the particulate phase under the inversion boundary.

Session 18 Micrometeorology - Part II

TOWARDS THE BULK PARAMETERIZATION OF THE ATMOSPHERIC BOUNDARY LAYER

Ian Edwards and Bryan R. Kerman

The observed structure of the universal functions of the planetary-boundary-layer resistance-laws under non-ideal conditions is described. An analysis of the deviations of the universal functions about their expected value for a given stability is attempted, based on a single parameter to represent baroclinicity. Initial results for a similarity structure under baroclinicity are inconclusive due to the unrepresentativeness of the horizontal temperature gradients of the field experiment. An analysis of the residual of the heat budget of the boundary layer indicates the presence of a large heating source with about a 10-hour periodicity, presumably associated with inertial oscillations and inversion entrainment. It is concluded that the usefulness of boundary layer parameterization in terms of Rossby number similarity may depend critically on formulating the memory aspects of the boundary layer flow, and that results based on local similarity may be inappropriate to some applications.

URBAN BOUNDARY LAYER STRUCTURES

R. C. Bennett and R. List

In order to study the urban boundary-layer, an acoustic radar was built at the University of Toronto Physics Department. It has been operating for more than a year and a half at the main campus in the center of Toronto.

Sound is scattered by mechanical and thermal turbulence. By illuminating the atmosphere with pulses of sound and monitoring the scattered energy, the location and relative intensity of turbulent regions can be determined. The recorded time-vs-height distribution of turbulent regions permits the characterization and analysis of boundary-layer structures.

A large variety of boundary-layer structures have been identified including thermal plumes, lifting of the mixing layer, waves and periodic structures, synoptic scale fronts and the effects of rain on the boundary-layer thermal-structure. A brief synopsis of the observed structures will be presented illustrating the value of the acoustic radar as a remote sensing tool.

RESULTS FROM SEA TRIALS OF A NEW BOUNDARY LAYER TETHERSONDE PACKAGE

R. E. Mickle and D. S. Davison

In preparation for the GARP Atlantic Tropical Experiment (GATE), the existing AES tethersonde package was substantially modified in order to meet the scientific requirements of the Boundary Layer Subprogram as recommended by WMO. The new tethersonde system was flown in April 1974, from the CCGS Quadra during sea trials held at Station Papa, 600 miles west of Vancouver Island in preparation for GATE. The results of these sea trials are discussed to show the

capabilities and limitations of the new tethersonde system.

EXPERIMENTS WITH THE ENERGY AND WATER BUDGETS OF THE CANADIAN MIDDLE NORTH

E. Vowinckel and Svenn Orvig

A computer model is used to calculate the elements of the energy and water budget. An existing energy budget model is applied to the Middle North Condition. In particular, the synoptic data for The Pas and typical Middle North surface, vegetation and soil conditions are used.

Session 19 Remote Sensing - Part II

AIRBORNE MEASUREMENTS RELATED TO WATER QUALITY

J. R. Miller

A four-channel spectral-scanning photometer, developed under contract to the Department of Energy, Mines and Resources, has been used during the summer of 1973 to make airborne spectral measurements over water. The photometer measures the water-backscattered radiation in the spectral regions 0.43 to 0.46, 0.55 to 0.59, 0.68 to 0.70 and 0.72 to 0.75 microns. Some field data is presented showing relationships between measured spectral changes and variations in water chlorophyll concentration and turbidity.

AN AIRBORNE FM-CW RADAR FOR MONITORING SMALL SCALE ATMOSPHERIC LAYERING EFFECTS

John H. Davies and Victor Ward

Ground-based radar-sounders for the study of refraction-index structures within the troposphere have been developed. These ground-based high-sensitivity FM-CW radars have typical maximum range-resolutions within the order of a meter or so. The requirements for high range-resolutions suggests the use of pulsed compression techniques. However any pulse radar imposes a restriction of a minimum range below which no return signal can be observed. The restriction arises because during the transmission of the pulse itself, no signal can be received, or usually for several pulses thereafter. Since it is the lower level inversions that frequently produce the scattering layers in the lower atmosphere, the radar technique which does not have these minimum-range restrictions is one that is required from the micrometeorological research standpoint. Consequently, work in this area has centered around the development of ground based FM-CW radars.

A knowledge of the reflectivity structure of the atmosphere is necessary for the specification and operation of a variety of systems in communication, radar, navigation and meteorology. The FM-CW radar sounding technique has shown itself to be a powerful aid in such studies, but, to date, all of these systems have been ground-based and operated from a fixed site. It would be advantageous therefore for a small lightweight airborne FM-CW system to be developed enabling rapid reconnaissance of the lower atmosphere to be undertaken. A feasibility study has been undertaken to investigate the possibilities of developing a small lightweight FM-CW airborne radar for monitoring small-scale refractive-index changes within the atmosphere which could lead to a better understanding of the lower atmosphere. The results of this initial study are reported upon.

LINE SCANNING OF FRESH WATER BODIES
K. S. Gordon

A line-scanner has been built to provide spatial scanning for an airborne interference-filter spectrometer. The interference filter is scanned sequentially through 15 visible bands and, by a technique of aircraft-motion compensation, the line-scanner registers 15 corresponding lines on the ground. Specifically, an attempt will be made to measure the concentration of chlorophyll in the water by examining the spectrum of reflected sunlight. Instrument design will be discussed and data from recent flights will be presented.

A SENSITIVE LASER METHOD FOR MEASURING WATER VAPOUR CONCENTRATION
Z. Kucerovsky and E. Brannen

The absorption of the 27.97 and the 33.02 micron radiation from a water vapour laser provides a sensitive technique for the measurement of water vapour concentration in the atmosphere. Experiments can be carried out in open or closed paths for effective lengths from 1 to 100 meters at ground level. Results of measurements taken under controlled conditions will be presented corresponding to atmospheric pressures for high and low altitudes. A typical sensitivity is that at 33.02 microns an absorption of 1% is produced in a 1 meter path-length by a vapour pressure of 11 microbars at ground level and 22 microbars at 5 kilometers. With 27.97 microns the absorption is about a factor 50 less and can be used for higher concentrations. For these sensitivities the response-time of the detecting apparatus is less than a second.

Session 20 Urban Meteorology

THE USE AND ABUSE OF THE URBAN MIXING DEPTH CONCEPT
Peter W. Summers

Since the urban mixing depth concept was developed over 10 years ago, based on rather sparse data in Montreal, it has been applied in several other cities with considerable success. Two further applications will be considered - (i) the relation between city size and pollution, (ii) whether the urban heat island does in fact mean a saving in the energy required to heat an individual house, and whether concentrating more people into urban areas would constitute a net energy saving for the total population.

Perhaps because of the success of the urban mixing depth concept, its use is now being at times extended unjustifiably to situations in which the original assumptions no longer apply. In particular, the use of a "standard" 5°F surface minimum temperature excess in a city to estimate from the rural temperature sounding an urban mixing height, can lead to serious errors and misinterpretations. This problem will be discussed and an alternative approach suggested.

SEASONAL EXCESS URBAN ENERGY AND THE NOCTURNAL HEAT ISLAND-TORONTO

D. Yap

The potential usefulness of the nocturnal boundary layer concept in the study of seasonal excess urban energy, necessary to generate similar and observed heat-island intensities in winter and summer, is demonstrated. For Toronto, a three-fold decrease (at least) in excess nocturnal heat from winter to summer is obtained. Energy-balance considerations indicate that this seasonal excess heat can be ascribed largely to anthropogenic heat release.

PRELIMINARY RESULTS OF AN ATTEMPT TO PARAMETERIZE THE ENERGETICS OF AN URBAN CANYON

M. Nunez and T. R. Oke

The urban surface energy balance remains exceptionally difficult to evaluate, but of central importance in understanding the urban boundary layer. This study attempts to employ a new methodology. The geometrical shape of an 'urban canyon' is identified as a basic unit of the urban/atmosphere interface. Careful analysis of the energy balance of the canyon surfaces, and contained volume, will enhance our knowledge of energy cycling within the urban roughness elements and provide a basis for realistic modelling. The objectives of the study presented here were to observe (via measurement) the nature of the energy exchanges involved in the canyon-volume energy balance, and to seek means of parameterizing the fluxes.

The canyon chosen was aligned north-south, the walls were white-painted concrete, the floor was gravel, and the dimensions were 6 m high, 8 m wide and 80 m long. Flux plates were embedded in the walls and floor, and a moveable suspended mast system permitted solar radiation, net radiation and air temperature profiles to be taken both across and along the canyon.

Results show that the mean albedo of the canyon-system is characterized by two distinct peaks during the day. These peaks are associated with the time of maximum solar irradiance of each wall. In agreement with theory, the canyon-system albedo at a given zenith and azimuth angle is less than for a similar horizontal surface. Similar comparisons were drawn for the net radiation and wall/floor heat flux densities. Especially at night the canyon-system net radiation and sub-surface storage showed differences when compared to an equivalent horizontal surface.

The linkages between the solar radiation, net radiation and storage terms appear to be identifiable. Further linkages required for complete energy-flow modelling are being pursued.

PLUME RISE MEASUREMENTS IN THE SUDBURY AREA

F. H. Fanaki

In order to determine the ground level concentration of pollutant from the Sudbury INCO tall stack (380 m), the rise of its plume was measured. The observations were supported by measurements of wind speed, wind direction, temperature and source parameters. This paper describes the experimental procedure adopted in this study and presents the analysis of the data. Several interesting features of the plume observed in this study are also described. The paper concludes with a discussion on the merits of the use of tall stacks.

ATMOSPHERIC POLLUTANT AND TEMPERATURE TRAVERSES IN AN URBAN AREA

T. J. Lyons and D. R. Cutten

In recent years climatology studies have indicated that modifications to the earth's surface, however small, alter the local micro-climate. A consequence of this is that clouds of atmospheric particulate matter are affected by the distinctive airflow and temperature of urban areas, especially during relatively calm periods.

In this paper, the temporal and spatial variation of ground-level particulate matter is investigated over the inner Adelaide area. Measurements of the level of particulate matter, and temperature were made on calm, cloudless nights. A visibility meter mounted on a vehicle that traversed a pre-determined route provided data on the concentration of particulate matter. Air temperature was measured from a second vehicle.

The more important observations include:

(i) the importance of variability of the direction of light winds on the dispersion of clouds of particulate matter,

(ii) the slow fall-off during the early hours of the morning in the level of pollutant arising from car emissions, and

(iii) the need for profile measurements within the urban complex.

Further studies are outlined for investigating areas of particulate matter in industrial areas.

Session 21 Remote Sensing - Part III

LIDAR STUDIES OF SMOKE PLUMES-A PROBLEM IN APPLIED METEOROLOGY

S. Peteherych, J. D. Houston, S. R. Pal and A. I. Carswell

An important concern of applied meteorology is the prediction of the effects of pollutant-emitting smoke-stacks on their neighbouring environment. This involves the development of models which describe the dispersal of emissions from such sources. Lidar observations greatly assist such a program in that lidar is an almost ideal tool for the accurate determination of the geometric parameters (e.g. plume rise, horizontal and vertical dimensions vs downwind distance) relevant to plume modelling. Observations have been conducted over a period of a year on several plumes including those of ore smelters and thermal generating stations. These data include: precise spatial measurements of plume cross-sections vs downwind distance, contour plots (in cross section) of particulate distribution within plumes vs downwind distance, depolarization measurements of backscattered laser light and simultaneous two-wavelength measurements of backscattered intensity. Depolarization measurements often vary systematically within a plume, suggesting corresponding variations in composition. This paper summarizes the important results of this work.

THE MEASUREMENT OF MICROMETEOROLOGICAL TEMPERATURE PROFILES BY THE INVERSION OF OPTICAL DATA

Alistair B. Fraser and William H. Mach

The image displacement that occurs when a mirage is seen is a consequence of the bending of the rays of light by a temperature gradient. Observations of the vertical displacement of the image should therefore provide a means of obtaining temperature profiles. The equations which enable this inversion to be performed

have been presented previously. A subsequent error analysis shows that if the optical measurements are made to an accuracy of five arc seconds, then the temperatures calculated for the profile should be in error by at most ± 2% of the total temperature range. As five arc seconds is experimentally feasible, the measurement of a micrometeorological temperature profile by the inversion of optical data is practicable.

MEASUREMENT OF VERTICAL AIR MOTIONS IN THE PLANETARY BOUNDARY LAYER USING AN ACOUSTIC ECHO-SOUNDER

H. Melling, R. List, R. C. Bennett and U. W. Rentsch

When an acoustic echo-sounder is operated in a vertically-directed monostatic mode, the mean Doppler shift in the frequency of sound scattered by small scale inhomogeneities in air temperature is proportional to the mean vertical velocity of the air in which these scatterers are imbedded. Thus, if this Doppler shift can be measured, vertical velocities may be determined in those regions of the atmosphere where there is thermal turbulence of intensity sufficient to be detected by the acoustic echo-sounder.

The University of Toronto system uses a digital frequency-counter to measure the mean period of the scattered sound. These measurements can be used to calculate vertical motions provided that the scattered sound amplitude is at least ten times the amplitude of the (narrow-band) background acoustic noise. To obtain sufficient accuracy in the velocity measurement, it is necessary to average successive measurements from the same height. When a maximum range of 700 meters is used, resolutions in the vertical velocity field are typically 30 meters in height, 60 seconds in time and ± 15 cm/sec. in velocity.

Measurements of vertical velocity taken at a height of 150 meters above street level during a period of thermal convection yield peak upward velocities of 1.3 m/sec., and peak downward velocities of -0.7 m/sec.

ATMOSPHERIC INSTRUMENTS NEW MARK II SODAR

M. G. Woodhead and W. L. Clink

This second generation Sound Detection and Ranging system is designed to operate from any suitable urban roof in support of Research and Operational objectives. It's a single-ended, vertical-sounding SODAR that ranges up to a kilometer or more to measure the intensity of small-scale temperature turbulance both as an indicator of the atmospheric mixing process and as a tracer of motion.

Among the design features of the system are:

1. Light weight transmitter-receiver construction for portability, with geometry based on door widths and the probability of horn arrays.
2. Custom designed hardware to provide:
   a. A repetition period that is randomly changed, by up to ± 6-seconds, about a 30-second mean.
   b. The ability to automatically alternate the cosinusoid-modulated sound burst between two selected carriers.
   c. The automatic insertion of Ranging and reference information into the recorder.
   d. Modular flexibility in transmitted power, pulse duration, carrier frequency, sounding depth or some above-ground-segment thereof.
3. The convenience of a recorder remoted on ordinary telephone lines.

Our Mark II program will provide a commercially procurable SODAR that is well engineered and sufficiently flexible to meet most operational and research demands for acoustic sounding of the lower atmosphere.

Session 22 General Meteorology

LINE ORIENTATION AS A FACTOR IN ICE AND SNOW ACCUMULATION ON OVERHEAD UTILITY WIRES

M. Pancura, B. A. Power, and G. Larson

A theoretical analysis of the physical and meteorological variables involved in ice and wet-snow accretion on overhead wires has shown that a key factor is line orientation relative to the storm wind direction. Formulae have been derived for computation of the radial ice or snow accumulation for the case of dry growth. Examples of the application of the formulae will be given.

A new directional "sleet rack" or iceometer will be described. Observed accumulations are in good agreement with those calculated from the formulae. An analysis of the requirements for improved ice measurement is given.

CLOSED-DRAINAGE LAKES ARE A CLIMATIC CHANGE INDICATOR

J. Whiting

A lake basin with no outflow channel is a dominant feature of an arid climate. The response time of these lakes is an indicator of climate change. The data for most closed lakes is readily available. Using Langbein's (1961) theories, 10 Saskatchewan Lakes have been compared to his study of 22 world lakes. The age of the Saskatchewan lakes was estimated using a climatic indicator, topographic shape and the rate of salinity increase. Big Quill Lake, an IHD project, was used as a representative basin.

The data bank for Big Quill Lake dates back to 1882. A time-series correlation relating 20 years of precipitation to lake-level changes shows that the carryover from past years is important. The response of this lake to climate can also be related to net evaporation.

PRESSURE SURFACES, CRITICAL ELEMENTS, AND NETWORK REPRESENTATIONS FOR DESCRIPTION, ANALYSIS, AND PREDICTION OF STRUCTURES AND FLOWS

William Warntz and Nigel Waters

Atmospheric pressure surfaces have no level areal elements. However, critical points with instantaneous gradient zero are identifiable in two categories of two types each, namely, absolute extrema (peaks and pits) and mixed extrema (passes and pales). Mixed extremum points occur precisely at self-crossings of single-valued out-loop or in-loop isobars.

Certain steepest-gradient paths define critical lines bounding highs and lows independently. Either taken separately exhausts total area. Every surface point thus always exists simultaneously in some high and some low. Groupings are not mutually inclusive, however. Varied multiple linkages exist but do satisfy topological connectivity theorems and thus allow representation of physical quantities from the entire system as localized and channelized in markedly simplified dual networks.

Framing these networks as matrices allows reduction to directed graphs

describable by diameter, cyclomatic number, and gamma indices, for example, relating to the system's complexity and expected motion.

Change toward equilibrium within the system may be modelled as a transportation programming problem with optimization as an iterative procedure confined initially to immediate linkages and then extended to successive resulting states. Alternatives are discussed in the framework of "level" *vs* "graded" systems as ultimate steady states. The idea is offered that this combining of critical elements of surfaces into simplified networks for matrix representations and computer-assisted operations may assist substantially the achieving of relevant numerical solutions to simplified forms of the non-linear partial differential equations of the system (using plausible approximations to initial conditions and boundary values) which now characterize the total surface step-by-step integration methods of numerical forecasting.

Specific examples given utilize Northern Hemisphere sea-level pressure distributions.

INTRODUCING METEOROLOGY TO SCHOOLS AND THE PUBLIC THROUGH NON-NUMERICAL SIMULATIONS

R. G. Lawford

The benefits of simulation games in the education system are described. A method for transforming the functions of a meteorological service into a simulation and subsequently into a game is discussed and the resultant product is demonstrated. Preliminary reactions from both teachers and students who have routinely used the game are reviewed. A second simulation game designed to stimulate discussion and study of the effects of geophysical phenomena on society is briefly described. The presentation concludes with an outline of potential applications of simulations in training and testing meteorologists.

EIGHTH ANNUAL GENERAL MEETING
CANADIAN METEOROLOGICAL SOCIETY

YORK UNIVERSITY, TORONTO
29 MAY 1974

AGENDA

The President in the Chair

1. Minutes of the 7th Annual General Meeting, 30 May 1973

2. Annual Report from the Executive
   (a) President's Report
   (b) Treasurer's Report
   (c) Other

3. Annual Reports from the Committees
   (a) Editorial Committee
   (b) Awards Committee
   (c) Citations Committee
   (d) Standing Committee on Public Information
   (e) Standing Committee on Scientific and Professional Matters
   (f) Other

4. Annual Reports from the Local Centres

5. Budget for 1975

6. Membership Fees for 1975

7. Speaker's Tour

8. Other Business

9. Report of the Nominating Committee and Installation of Officers

CANADIAN METEOROLOGICAL SOCIETY

SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA

SEVENTH ANNUAL GENERAL MEETING - CANADIAN METEOROLOGICAL SOCIETY

Minutes of the Seventh Annual General Meeting of the Canadian Meteorological Society held at the St. Mary's University on Wednesday, May 30, 1973 commencing at 7:15 P.M.

Present: 53 members. The outgoing President, G.A. McKay, was in the chair.

1. Minutes of the 6th Annual General Meeting, May 31, 1972.

Dr. Roland List moved adoption of minutes as printed, seconded by François Lemire - approved.

2. Annual Report of the Executive Committee

a. President's Report

G.A. McKay touched on the highlights of his report printed in the 7th Annual Congress Issue of Atmosphere.

b. Treasurer's Report

Mike Webb outlined his report printed on page 34 of the 7th Congress Issue. Expenditures and receipts for the year ending December 1972 were both within a few dollars of $11,500.

Dr. Sven Orvig raised the question of the CMS possibly having a fiscal year beginning in the spring or summer.

Dr. List questioned the large difference in cost between the Congress and Regular issues of Atmosphere. The difference was attributed to such things as diagrams, number of pages, editing, etc.

Mr. Webb moved the financial statement be accepted, seconded by George Pincock - carried.

Executive-	
President	G. A. McKay
Vice-President	W. F. 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

2.4 Editor's Report - Mr. Penner touched on the highlights of the Editor's Report and noted that the Atmospheric Environment Service had placed a recent order of 200 subscriptions to Atmosphere to begin with Volume 10 #1. Mr. Penner answered questions regarding Atmosphere.

2.5 Report of the Awards Committee - Mr. Penner presented the report which had been approved by Council. The awards were as follows:

The President's 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- Dr. J. S. Marshall for his work published as "Peak readings and thresholding in processing weather radar data." Journal of Applied Meteorology, December, 1971.

Graduate Student Prize- R. S. Schemenauer for his work described in his M.Sc. thesis at the University of Toronto "Measurement of the Drag Coefficients and Characteristic Motions of Snow Crystals, Graupel and Small Hail Models". It was published in the Journal of Atmospheric Science, January, 1971 by List and Schemenauer under the title "Free-Fall Behaviour of Planar Snow Crystals, Conical Graupel and Small Hail".

The Dr. Andrew Thomson Undergraduate Student Prize - Mr. Tom Low for his B.Sc. thesis at the University of Toronto in 1971 entitled "A Study of Collisions between Raindrops and Metal Chaff".

Mr. Penner presented the President's Prize to Dr. Kwizak while Prof. Hitschfeld is to arrange a presentation to Dr. Robert at the Montreal Centre.

Arrangements will also be made to present the Prize in Applied Meteorology to Dr. Marshall in Montreal.

3. Reports of Standing Committees.

a. Public Information

The report as printed on pages 38 and 39 in the Congress Issue was presented by the Chairman, Herb Kruger.

Keith McGlening enlarged on Mr. Kruger's recommendations regarding a Weathercaster's conference by describing similar activities by the AMS.

b. Scientific and Professional Matters.

The report, as printed in the Congress Issue, was commented on by Dr. Barney Boville.

The results of the Committee's meeting of May 29, 1973 were summarized: the acronym SOMAS will be retained and used for the name of this Committee (it will now stand for Subcommittee on Matters relating to Atmospheric Science); the CMS should carry out a manpower survey of the profession in Canada; the AES should inform the Committee on the time and details of the policy change-over to the Research Agreements from the University Grants; the connection with NRC will be phased out within the year; CMS will explore relations with C.A.P. - mainly the aeronomers; it was confirmed that the GARP Scientific Committee, should continue to report to SOMAS (of the CMS).

Drs. List, Hitschfeld, Robert and others discussed in more detail the kind and amount of the total Canadian requirement for meteorologists at the MSc and PhD level. Dr. Robert volunteered to report to Dr. List on an impending 2-day meeting to be held at U. of Quebec in Montreal which will cover just this question.

4. Reports from Local Centres

4.1 Vancouver Centre - Dr. Mike Miyake briefly covered the report written by Gary Schaefer, but which failed to make the Congress Issue printing due to mailing difficulties. Last year's active program of the Centre was reviewed.

4.2 Alberta Centre - Dr. Ed Lozowski covered the report briefly, roughly as printed in the Congress Issue. He added a comment on Dr. Dick Longley's commendable effort in reviewing present high school text's in North America covering meteorology. Dr. Hitschfeld commented on the possible channeling of this effort toward the Provincial Educational interests.

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.
Carried.

6.2 Moved by Mr. G. A. McKay and seconded by Mr. G. W. Robertson that the following changes be made:
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.
Carried.

7. Other Business

7.1 Moved by Dr. J. M. Powell that the Canadian Meteorological Society write a letter of thanks and appreciation to the Alberta Government for sponsoring the dinner for the Sixth Annual Congress on June 1, 1972. Seconded by Mr. G. A. McPherson and carried unanimously.

7.2 Mr. Penner advised the meeting of a proposal by Mr. M. Newark that the Society publish a high school meteorology text. The Executive will continue to investigate the suggestion in conjunction with Mr. Newark.

8. Installation of Officers

8.1 Mr. Penner welcomed the new members of the 1972-73 Council and turned the meeting over to Mr. G. A. McKay, the incoming President.

8.2 Mr. McKay expressed thanks to the outgoing executive prior to adjourning the meeting at 10 P.M.

(A. H. Campbell)
Recording Secretary

6. Membership Fees

Mr. Webb moved that the fee structure remain unchanged - seconded by Mr. Kruger - carried.

7. Speaker's Tour

Mr. McKay mentioned the change in AES policy regarding having the speaker's tour somewhat earlier.

Dr. Maybank suggested that consideration be given to other Speakers making limited tours and/or a CMS President's tour.

8. Other Business

Re-coupling the CMS Congress with the Learned Societies or CAP

Dr. Orvig raised the question of rejoining the Learned Societies. Discussion followed by Mr. McKay, Drs. Hitschfeld, List, Maybank and others. In general the meeting seemed to agree on trying to phase in with the Learned Society at Laval in 1976.

1975 Congress Location

Dr. Miyake, as outgoing Vancouver Centre Chairman, offered the Vancouver Centre as host for the 1975 Congress.

Possible Joint Meeting with the French Meteorological Society

Mr. McKay reported that Mr. Penner was looking into the possibilities of a joint meeting.

Vote of thanks to Halifax Centre for 1973 Congress

Dr. Dick Douglas formally moved that thanks be expressed to all of the host Halifax Centre members who have done so much work organizing this Congress. The loud applause recorded unanimous carrying of this motion.

OPERATING BUDGET FOR 1972

RECEIPTS

Fees -general	500 @14.00	7000.00	
-student	100 @ 2.00	200.00	
Subscriptions	100 @10.00	1000.00	
		8200.00	
Sustaining Memberships	2 @40.00	80.00	
Subscriptions for A.E.S.	200 @10.00	2000.00	
TOTAL			$10,280.00

EXPENDITURES

Atmosphere -handling (20% of 8200)		1640.00	
-printing (4 issues @1700)		6800.00	
		8440.00	
Congress Issue and Mailing		900.00	
Prizes		100.00	
Auditor		30.00	
Support for Activities of Centres		300.00	
Grants -SCITEC		50.00	
-Youth Science Fair		50.00	
Operating Costs of Executive		450.00	
TOTAL			$10,320.00

BUDGETED DEFICIT $ 40.00

PRESIDENT'S REPORT

The Canadian Meteorological Society in 1973

The CMS has begun to benefit from generous support from the Atmospheric Environment Service, given with the approval of the Treasury Board. These funds allow the Society to implement improvements in our publications program, to initiate a program of modest subsidies for the Centres, and to begin a series of information services which should benefit the profession and the country.

1973 was the year of great development in our publications policy. In the early spring, the Executive launched the *CMS Newsletter* (of which seven appeared during the year). At first these were distributed only to Council members and made available to other members through them; eventually the *Newsletters* were mailed to all members. The content has so far tended to be of a somewhat administrative nature, summarizing the flow of business at Executive and Council meetings. But the groundwork has been laid to supplement this by brief and prompt reportage on all events likely to interest and affect the Canadian meteorological community, and which the public media would usually not carry, at least in adequate detail.

At the same time *Atmosphere* through its four issues (including the spectacular Andrew Thompson 80th Anniversary Issue) has made great progress towards making itself an important medium of dissemination of meteorological science. Volume 11 edited by E. J. Truhlar was still by design a mixed vehicle of scientific articles, popular general-interest material, and official announcements. From Volume 12 No. 1 on, and under the editorship of Dr. Ian Rutherford, *Atmosphere* will confine itself to science, and in the Congress issue to official announcements. The *Newsletter* will increasingly take over the more general material. If growth in this category becomes excessive and upsets the publication schedule of the *Newsletter*, a new popular medium may have to be created.)

A significant step has been the introduction of a simple formula to subsidize our Centres: in 1973, $1664 was distributed, and plans are in hand to double this amount by 1976. So far, this money has been used to promote meteorology in all parts of the country by displays, speaker programs (both in the Centres and under their sponsorship in surrounding schools and colleges), and through other means.

A booklet has been commissioned to describe meteorological activity – professional scientific and educational – in Canada. It is intended for the general public and the schools. For the future, releases on more controversial issues are also contemplated.

1973 and 1974 are years of transition in the structure of our Standing Committee on Matters pertaining to Atmospheric Science (SOMAS) which until March 1974 was responsible jointly to us and the National Research Council. (Until March 1972, SOMAS - then the Subcommittee on Meteorology and Atmospheric Science - was part of the NRC committee structure.) It is now a committee of the Society, and charged with the important responsibility of articulating meteorological opinion on Canadian issues, to formulate advice the Society should tender to governments and to the public, and in general with the oversight of the scientific and professional quality of our activities.

One of its continuing responsibilities deserves special mention: The coordination of the Canadian contribution to GARP, a task SOMAS has confided to a special committee. Activities include annotated directories on Canadian GARP activities (one appeared in 1971), a second is due in mid-1974), and advice to the GARP Coordinating Committee, which is a body set up by the National Research Council to fund GARP activities in the Universities.

The Society has supported SCITEC (The Association of the Scientific, Engineering and Technological Community of Canada) since its inception. Our support has been modest, commensurate with our means. We should be able to increase our contribution, and we should want to do so, since SCITEC is beginning to show its mettle, and may soon be able to offer us important services through HOST (The House of Science and Technology) it proposes to open in Ottawa. We cannot be sure that SCITEC, or any other agency, will ever be able to give the kind of pointed and coherent advice to the government that has sometimes been desired, but our participation in SCITEC will keep us alert to the problems of the day, and will allow us to see the problems of meteorology as a part of the wider picture of science and technology in Canada. And through HOST, it will provide the Society with an efficient and inexpensive secretariat.

Outlook

Building on the good base laid in recent years, and with the new financial support, the Society is determined to play the important role of representing meteorological opinion to the public and governments. We will attempt to do this through our publications and public information programs, through SOMAS, through our Centres and through our participation in SCITEC.

CANADIAN METEOROLOGICAL SOCIETY STATEMENT OF RECEIPTS AND EXPENDITURES FOR THE YEAR ENDED DEC. 31, 1973

RECEIPTS		
Donations (prizes)	58.40	
Sustaining Membership	50.00	
AES Grant	6500.00	
Other Income	211.84	
Sales of Atmosphere-Reprints	2871.84	
Dues and Subscriptions[1]	11632.20	
		21,324.28
EXPENDITURES		
Prizes	128.47	
Centers	1664.00	
Scitec	325.00	
Auditor	30.00	
Youth Science Fair	50.00	
Congress Issue Atmosphere	1131.47	
Newsletter 1-5 (printing only)	123.19	
Printing of Atmosphere (Reprints)	9317.57	
Travel	446.09	
Service Charge-Commission - U of T	2326.14	
Operating Expenses	500.81	
Print (Constitution, Member List, Mailing)	745.23	
		16,787.97
CASH ON HAND Dec. 31/72		
Bank Account	3387.51	
U of T Press	- 2365.57	
TOTAL	1021.94	
Plus Receipts	21324.28	
Less Expenditures	16787.97	
		5,558.25
CASH ON HAND Dec. 31/73		
Bank Account	7600.10	
U of T Press	- 2041.85	
		5,558.25

[1] Includes part collection of dues for 1974

OTHER ASSETS

Bell Canada 12 Shares @40.00		480.00
Canada Savings Bonds - Series 24		950.00
Accrued Bond Interest 1970-1974		
1970 - 7% of 950.00	66.50	
1971 - 8% of 950.00	76.00	
1972 - 8% of 950.00	76.00	
1973 - 8¼% of 950.00	78.38	
		296.88

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, 1973.

R. D. Easto
Auditor

BUDGET FOR 1975

INCOME

Dues and subscriptions	12500.00	
Other income	3500.00	
Grant	16000.00	
		32,000.00

EXPENDITURES

Operating Costs (a) Basic	4000.00	
(b) SOMAS	3200.00	
Support to Centres	2500.00	
Annual Congress	1300.00	
Information Services	2300.00	
Publications	18000.00	
SCITEC	700.00	
		32,000.00

EDITORIAL COMMITTEE REPORT

A subtle evolution in *Atmosphere* took place during 1973, since the *CMS Newsletter* provided a new medium in which to publish Society news, announcements and other items of interest to members only. Greater scientific content therefore resulted, which indicated the thrust of future editorial policy – to publish original scientific research papers, reviews, critiques or commentaries in the field of atmospheric science.

The AES grant stabilized the Society's operating fund and permitted a unique final issue to be published for Vol. 11 1973, comprising 12 invited articles contributed by the friends, colleagues and associates of Dr. Andrew Thomson to honour his 80th birthday. This issue amounts to 84 pages and serves as an indicator of the possibilities which lie ahead for *Atmosphere* as a thriving journal. However, to achieve this aim and to increase the stature of the journal requires continuing cooperation and support from CMS members. The enthusiastic response of those who contributed to the Dr. Thomson issue is convincing evidence for the existence of this support.

Inflationary and environmental stresses will affect the CMS budget through the increased costs required to produce *Atmosphere*, authors' reprints, the *CMS Newsletter*, and other printed material distributed by the Society. The price of paper skyrocketed during 1973, increasing by about 34% over a 12-month period. The basic cost to produce 1000 copies of a 32-page issue rose by 27% (from 1341 to 1697), exclusive of charges for authors' alterations and additional engravings or artwork. Even if this financial trend should moderate during 1974, rising production costs are inevitable, necessitating continued outside support (grants) as well as increased fees from members and perhaps institutional subscribers.

The following statistics reveal a modest scientific development of *Atmosphere*. Five issues were printed: Vol. 10 No. 4, Vol. 11 Nos. 1,2 and 3 (164 pages, 16 more than in 1972); and the Congress issue (47 pages). These contained 12 articles, 8 book reviews, 5 scientific notes, 3 reports on scientific meetings, 11 notes relating to the CMS, 5 announcements, 1 letter and 1 other report; as well as the program and abstracts for the 7th Annual Congress and the Society's annual reports. *Atmosphere* clearly remains a generalist meteorological journal presenting results from a wide-range of Canadian research activities.

Membership in the CMS decreased by 15 (Members, +10; Student Members, -25), Institutional subscriptions increased by 12, so that the total subscription list has remained relatively constant.

University libraries and bookselling agencies placed 15 orders for back issues of *Atmosphere*, producing new revenue in the amount of $557.50.

Five issues of the *Newsletter* were distributed to all the members who generally welcomed it not only as a vital communication link with the CMS Executive but also as a timely source of information about Society activities not otherwise available. Dr. Treidl's lively (almost breezy) editorial style was conducive to the success of this new venture.

I am grateful to all those who contributed their efforts as author, critic, adviser, reviewer or technical assistant to help further the CMS aim, "the advancement of meteorology", through the publication of *Atmosphere*. Best wishes are extended to the new Editor, his committee and staff in their sometimes onerous but always challenging and rewarding future endeavours.

E. J. Truhlar
Editor, Atmosphere

AWARDS COMMITTEE REPORT

The Awards Committee for 1973 offers the recommendations listed below, together with brief statements of the reasons for our recommendations:

President's Prize: Dr. A. J. Chisholm and Dr. Marianne English

For their extensive and outstanding work over a period of many years on the structure of hailstorms and the growth trajectories of hailstones culminating in the publication "Alberta Hailstorms", American Meteorological Society, Meteorological Monograph No. 36, 98 pp., November 1973.

Prize in Applied Meteorology: H. P. Wilson

For his long career devoted to the practical application of meteorological techniques to forecasting in the Canadian Arctic and the comprehensive accumulation of his knowledge and experience in the useful reference guide "Arctic Operational Meteorology - A Study Guide for Arctic Weather Forecasters", Queens Printer, Edmonton, June 1973.

Graduate Student Prize: Yong-Seung Chung

For his valuable contribution to solving the problem of forecasting lee cyclogenesis, resulting from his Masters thesis work at the University of Alberta and described in the paper (co-authored with E. R. Reinelt) "On Cyclogenesis in the Lee of the Canadian Rocky Mountains", *Arch. Met. Geoph. Biokl., Ser.A,* 22, 205-206 (1973).

Dr. Andrew Thompson Undergraduate Student Prize: M. A. Tilley

For her work as an AES summer student which resulted in the paper (co-authored with G. A. McBean) "An Application of Spectrum Analysis to Synoptic Pollution Data", *Atmospheric Environment,* 7, 793-801 (1973)

Peter W. Summers
Chairman

CITATIONS COMMITTEE REPORT

The Committee recommends that the following individuals be awarded CMS citations for the reasons noted:

1. Dr. John A. Livingston, Faculty of Environmental Studies, York University, for his book "One Cosmic Instant" (McClelland and Stewart, Toronto 1973) in which he presents a powerful argument for an environmental ethic and outlines how it might be achieved.
2. Professor Pierre Dansereau, Centre de Recherche en Sciences de l'Environnement, Université du Québec à Montréal, for his work in directing the interdisciplinary scientific research program on the ecology of the new Montreal International Airport area, for his efforts at bringing environmental concerns to the attention of the general public, and for his work in various capacities in helping to develop enlightened environmental policies.
3. Dr. P. D. McTaggart-Cowan, Executive Director of the Science Council of

Canada, for his pioneering work in the organization of oil-spill clean-up operations, for publicly exposing the general negligence which characterizes many tanker operations, and for his far-sighted recommendations, many of which have been or are being implemented, on how to minimize and deal with oil-spills.

H. B. Kruger
Chairman

REPORT OF THE STANDING COMMITTEE ON PUBLIC INFORMATION (SCPI)

The members of the committee for 1973-74 were as follows:

J. Vanier	Chairman
H. B. Kruger	Liaison Officer (Past Chairman)
Dr. A. J. Chisholm	Toronto Center
D. A. Faulkner	B. C. Center
M. G. Ferland	Centre Québécois
H. M. Fraser	Winnipeg Center
A. D. Gates	Halifax Center
J. R. Hendricks	Regina Center
A. Ouellet	Montreal Center (Média de langue française)
N. N. Powe	Montreal Center (English language media) Interim Chairman
D. J. Webster	Ottawa Center
H. P. Wilson	Alberta Center

Mr. H. B. Kruger resigned last summer from his position of chairman; he felt that it was highly desirable for the chairman of the SCPI to be co-located with the national Executive to fulfill properly his duties. N. N. Powe accepted to step into the position of chairman but soon after he also had to resign, for reasons of ill health. J. Vanier accepted to serve a term as long as the national Executive is in his centre. He feels that it is essential that the chairman of SCPI be co-located with the national Executive.

The following is a brief outline of some of the activities of the Committee during the year:

1. The "Ask Andy" syndicated column is still continuing its devastating effects and carries on as a frequent source of nonsense and misinterpretation of scientific knowledge on meteorology. Even if this column is written for the child it is often read by the adult. This subject will be a matter of discussion at the weathercasting session in connection with this Congress. It has been suggested that SCITEC should play a prime role in this controversy.
2. Mr. D. A. Bernachi of Saskatoon found trivial errors and oversimplified explanations of weather phenomena in the book "Science Activities Resources Book", Intermediate Division, published by Gage. Mr. Lee of Gage publishing Co. passed the comments to the author for changes, in case the book is to be reprinted. At the same time Mr. Lee informed the SCPI that the present science curriculum at the elementary school level is in a state of flux and under revision. They are trying to determine whether revisions of their present book are justified, or whether the need for new science publications can be defined on a national basis.

3. The CMS Executive feels that it is more than urgent to produce a booklet for public dissemination. The booklet should have as its theme "Meteorology in Canada" and should deal in particular with career opportunities in Meteorology and the goals and activities of the CMS. Mr. J. J. Moakler has agreed to act as editor. The CMS Executive would like to publish this booklet in time for the 9th Annual Congress in 1975.

To conclude this report, I would like to urge all CMS members to contact their local centre and inform the SCPI representative on everything that can advise the Executive Committee of the Canadian Meteorological Society on matters within the concern of the Society which might require the provision of information to the public in general or to specific groups. Such studies and reviews may be made on the request of the Executive Committee or on the initiative of the Standing Committee.

J. Vanier
Chairman

REPORT OF THE STANDING COMMITTEE ON SCIENTIFIC AND PROFESSIONAL MATTERS

The current membership list of the committee is as follows:

Expiring in 1974	Dr. B. W. Boville Professor M. B. Danard Professor E. P. Lozowski Professor M. Miyake
Expiring in 1975	Professor J. Derome Dr. C. L. Mateer (Secretary)
Expiring in 1976	Professor F. K. Hare Professor R. List (Chairman) Dr. J. Maybank Professor S. Orvig
Ex Officio	Professor W. Hitschfeld, President, CMS. Professor A. W. Brewer, GARP Co-ordinating Committee (GCC). Dr. W. L. Godson, Director-General, Atmospheric Research Directorate.

Noting the four memberships expiring in 1974 and considering the need for a balanced distribution of members from the geographical regions, from the government - industry - university communities, and from the various sub-disciplines, the committee recommended that the following be invited to serve for the period 1974-77:

Dr. W. Baier,
Dr. D. M. Leahey
Dr. G. A. McBean
Dr. S. D. Smith
Mr. J. B. Wright

The committee decided that Dr. Boville should be Acting Chairman for the period April 1 to August 31, 1974, during the absence of Professor List on sabbatical leave.

The committee met for the last time as an NRC/ACGG subcommittee at NRC in Ottawa on February 20, 1974. From April 1 onwards, SOMAS will be solely a standing committee of the CMS.

With the committee now coming fully under the aegis of the CMS, certain matters pertaining to terms of reference, membership, officers and finances, which are not covered specifically in the CMS Constitution and By-Laws (other than By-Law 5 (c)) require formalization. At two meetings during the past year, SOMAS has passed the following resolutions relevant to the above, which are submitted herewith for consideration by Council.

Terms of Reference

To study and report to the executive committee from time to time on matters pertaining to meteorology and atmospheric science when directed by the executive or on the initiative of the Standing Committee itself.

Name and Acronym

To keep the same acronym SOMAS, which would now stand for "Standing Committee on Matters pertaining to Atmospheric Science".

Budget

That the budget be approved and forwarded to CMS executive.

Membership

The Chairman and Secretary of SOMAS shall not hold office for more than three consecutive years and, except for the Chairman and Secretary, no one shall be a member of SOMAS for more than three consecutive years.

Historically, the Chairman and Secretary of SOMAS have been elected by the members. New members have been elected by SOMAS and appointed by NRC. The direction and instructions of Council on these matters is requested.

SOMAS has also decided that committee meetings should continue to be open to all interested persons, that the Director-General, Atmospheric Research Directorate, AES should be invited to attend meetings on a regular basis, and that the Secretary should send synopses of SOMAS meetings to the Editor of the CMS Newsletter.

The following activities are among those undertaken by SOMAS in 1973-74:

1. The Canadian GARP Scientific Committee (GSC) continued its activities as a subcommittee of SOMAS, under the chairmanship of Professor M. B. Danard. The GSC is preparing a more up-to-date statement of the "Canadian Plans for Participation in GARP". This will include descriptions of GARP sub-programs as well as current and proposed research by Canadian scientists. The booklet will be published in the summer of 1974.

SOMAS appointed the following people to serve as members of GSC after the CMS meetings in 1974: Professor Austin, Professor Derome, Professor List, Dr. McBean, Professor Merilees, Professor Miyake and Dr. Robert. A new chairman will be appointed by the chairman of SOMAS.

SOMAS directed that "GSC should examine the relevance of GARP-related programs to Canada and report to SOMAS and GCC at frequent intervals".

2. SOMAS continued its discussion and examination of scientific and professional manpower needs in the Atmospheric Sciences.

3. The committee considered the impact of the federal government's Make-or-Buy policy, the science subvention program of AES and the NRC grants program on research in the Universities. In particular, the AES was asked to provide early guidance on procedures to follow in the new science subvention (research agreement) program which replaced the old AES grants program.

4. SOMAS decided to propose a joint CMS-CAP session for the CAP meetings at the University of Toronto in 1975. This would probably be a half-day session with about four summary papers on the upper troposphere and higher levels. SOMAS noted that CAP has formed a new "Division of Aeronomy and Space Science", the terms of reference and name had been modified after discussion and it was suggested that CMS and CAP representatives should explore further cooperation.

5. SOMAS noted the following programs with interest:

(a) The University of Toronto has received an NRC development grant to develop an atmospheric dynamics research program and will be recruiting three young scientists in 1974 and 1975.

(b) The Alberta government is proceeding with a 5-year plan for operational seeding of hail clouds within an 80 mile radius of Penhold. Seven aircraft are to be used in 1974 summer operations.

(c) The Atmospheric Environment Service, in cooperation with several universities, is to make two stratospheric balloon flights this summer. Purpose of the flights is to gain information on factors influencing the ozone balance and to gain insight into possible environmental problems caused by supersonic transports.

Dr. B. W. Boville
Acting Chairman

REPORTS FROM LOCAL CENTRES

VANCOUVER CENTRE

The Centre held five formal meetings during the period January 1973 to March 1974. Attendance at the meeting was somewhat disappointing, varying from 15 to 30, but all visitors stimulated a great deal of discussion and interest among their audience.

At the first meeting, 25 January, 1973, Dr. M. C. Quick of UBC gave a comprehensive account of the approaches to, and the problems of, 'Fraser River Flood Forecasting'. Dr. P. Tyson of South Africa spoke on 'Topographically Induced Local Winds' 3 April 1973, introducing models of both meteorological and geographical interest. 'Glaciation and Climatic Change' was the topic addressed by Dr. R. G. Barry of the University of Colorado, 20 September, 1973, with emphasis on the significance of current meteorological research. Dr. N. Trivett of the Atmos. Environment Service gave a wide-ranging account on 'Aspects of Evapotranspiration' on 11 December, 1973. The AES tour speaker, Dr. A. G. Davenport of the University of Western Ontario visited Vancouver on 4 March, 1974, and spoke on 'Strong Winds and Structures'. He amply demonstrated the vital role of applied meteorology in the field of engineering design and flavoured his talk by the use of interesting local examples.

The present executive, D. A. Faulkner, M. Miyake, T. R. Oke, R. B. Sagar and D. G. Schaefer have been engaged in preliminary work for the 1975 National Congress of the Society in Vancouver. A new executive and a Congress Organizing Committee will be elected at the AGM planned for late April.

ALBERTA CENTRE

Executive of the Alberta Centre during 1973-74:

Chairman - F. E. Burbidge, AES Western Region, Edmonton
Secretary-Treasurer - L. Wojtiw, Alberta Research, Edmonton

The Centre held five meetings in Edmonton and will hold one in Calgary this year. The subjects ranged from Hail to Winds to Air Pollution. The speakers and topics are listed below:

Nov. 21, 1973	Dr. Bob Charlton and Dr. Madhav Khandekar, University of Alberta - "A proposal to study Air Pollution in Alberta."
Dec. 12, 1973	Mr. H. P. Wilson, Edmonton, "Winds and Currents in the Beaufort Sea".
Jan. 30, 1974	Mr. G. Strong, University of Alberta "Measurements of Hail Impact Energies from Central Alberta Hail Storms".
March 5, 1974	Dr. A. G. Davenport, University of Western Ontario "The Importance of Meteorological Information in Civil Engineering".
	"Strong Winds and Structures".
March 26, 1974	Dr. G. G. Goyer, National Centre for Atmospheric

Research, Boulder, Colorado.

"The U. S. National Hail Research Experiment".

May 1974 — Dr. Scorer, Imperial College, London, England
"Lee Waves and Clear Air Turbulence".

Special Events: The Alberta Centre was very fortunate to have had such outstanding scientists as guest speakers during the past year. The proposed visit by Dr. Scorer in May will be the highlight of this season. He will be attending the "Man and His Environment" conference in Banff, and he has kindly consented to stop over in Calgary and present a paper to our Alberta Centre.

The funds that were sent to the Alberta Centre by the CMS executive have been mainly used for postage, letters etc. and these expenses are estimated to amount to $40.00 by the end of this term. Some of the remaining funds will be required to help defray expenses for the May meeting in Calgary with Dr. Scorer. A detailed account of the 1973-74 expenses will be sent after this last meeting.

Elected for the 1974-75 season by the Alberta Centre:

Chairman: Dr. E. P. Lozowski, Geography Department
University of Alberta,
Edmonton, Alberta

Secretary-Treasurer: L. Wojtiw,
Alberta Research Council,
87 Ave. & 114 St.,
Edmonton, Alberta

REGINA CENTRE

The executive for 1973-74 consisted of Mr. John Dmytriw, Moose Jaw (Chairman) and Mr. Alec Paul, Regina (Secretary-Treasurer). The especially severe winter on the prairies did not apparently serve to increase general interest in the Centre's meetings! Attendance remained at last year's level.

The first meeting of the session on October 24 was a panel presentation and discussion of the August 27, 1973 thunderstorm outbreak in eastern Saskatchewan. Wind, rain, hail and lightning took a heavy toll in some areas, Yorkton in particular, and the Cedoux area was pounded by some of the largest hailstones ever reported on the prairies. Mr. L. S. Meeres and Mr. L. Romaniuk of the Regina Weather Office talked about the synoptic situation and the post-storm survey respectively. Professor E. Lozowski discussed the form and structure of the softball-sized hail-stones, and Mr. A. Paul reported on the detailed hail survey of the Regina-Moose Jaw area storm carried out by the Saskatchewan Hail Research Project (SHARP).

On November 21, Mr. J. R. Hendricks of the Regina Weather Office presented a paper on "Extreme temperatures at Regina." He dealt with probabilities of certain temperatures being experienced at Regina, both inside and outside the range of our period of record. Some of his papers on this work have recently been published and he is now examining the extension of the technique to other weather parameters.

We received the AES/CMS visiting lecturer, Professor A. G. Davenport, on March 6. His subject was "Strong Winds and Structures," but he gave us much more than he promised, dealing with snow loads as well, and showing an excellent movie of the work of the wind tunnel group at the University of Western Ontario. This topic covered an important area of involvement between the meteorologist and other members of the community, and attracted engineers and planners as well as meteorologists.

Our final meeting of the year will take place in late April when we plan to follow up the successful introduction last year of a dinner meeting. Next year's executive will likely be elected at that time. The present executive would like to close by thanking the CMS Council for its assistance, and wishing Mr. Syd Buckler, a tower of strength to the Regina Centre over the past several years, a happy retirement in the Far West.

WINNIPEG CENTRE

Summary of Meetings: 1. September 28th, 1973, dinner meeting at the Officer's Mess, CFB Portage la Prairie. The speaker was Dr. Putt, director of the Morden Research Station. He discussed the research activities of the Morden Research Station.

2. November 14th, 1973, lecture meeting held at Winnipeg International Airport. The speakers were Mr. D. McGeary, Mr. R. C. Jacobs, and Mr. N. Barber. They talked of their impressions of Severe Local Storms Convention, Denver, Colorado, and Cumulus Modelling Symposium, Boulder, Colorado.

3. January 16th, 1974, dinner meeting at the Winnipeg Flying Club. The speaker was Dr. Thorsteinson, Professor of Entomology at the University of Manitoba. He discussed the way weather parameters influence mosquito production and dispersal.

4. March 7th, 1974, dinner meeting held at Woo's Marigold Restaurant. The speaker was Dr. A. G. Davenport, Professor at the University of Western Ontario. He was the annual CMS/AES sponsored speaker and he talked of strong winds and structures.

5. To be held April 18th, 1974, a dinner meeting at Woo's Marigold Restaurant. This will be the Annual Meeting. Mr. M. K. Thomas, director of the Meteorological Applications Branch, will be present to discuss "climatic change".

Science Fair: The University of Winnipeg sponsors a yearly Science Fair which is open to Manitoba schools. Two awards are given for the best Meteorological display. The award is a plaque and a cash award.

Burn Lowe Award: The Burn Lowe Award was initiated in 1967 by the Winnipeg Centre of the Canadian Meteorological Society, to be awarded annually to a person, in the area of interest to the Winnipeg Centre, adjudged to have made a significant contribution to meteorology. This award is made in memory of a very enthusiastic and prominent meteorologist of the Winnipeg area who passed away in 1966. It will be presented at the Annual Meeting.

WMO Day: World Meteorological Day was observed by two television appearances by D. Siemieniuk, by a Media Open House held at the Winnipeg Weather Office on March 23rd, 1974, and by a press release.

TORONTO CENTRE

The Toronto Centre was involved in three organized types of activities during the 1973-74 season; the Speakers' program, planning and preparation for the 8th Annual CMS Congress and a Public Service Program made possible by the financial support from the National to the Local Centres.

Speakers' Program

Four speakers gave presentations between October and March and a fifth meeting was planned for the beginning of May at which time the 1974-75 executive would be elected. The speakers and their topics were:

Dr. R. E. Munn	-	"Monitoring and Assessment of the World Environment"
Mr. K. T. McLeod	-	"Meteorology in the Middle East"
Dr. A. G. Davenport	-	"Strong Winds and Structures"
Mr. J. P. Bruce	-	"The Interaction of Meteorology and Water Resources Management"
Mr. D. A. Bondy	-	"The James Bay Project"

All meetings were held at the Atmospheric Environment Service Headquarters auditorium and the attendance varied between 30 and 50.

8th Annual Congress

Planning for the Annual Congress, which began early in September moved into the count-down stage by the end of March. The organization of the local arrangements and programs involved E. J. Axton, Bhartendu, W. J. Crowley, W. R. Frisken, K. D. Hage, K. L. McGlening, G. J. Miller, B. J. O'Donnell and M. S. Webb co-operating with the program chairman and local arrangements chairman, G. A. McBean and R. A. Miller.

Public Service Program

The Toronto Centre decided that their greatest impact in advancing meteorology could be achieved through the existing educational system. Consequently, the Board of Education for the City of Toronto was approached with the offer of:

(a) A seminar program on meteorology for Geography and/or Science teachers to be organized by the school systems but to be funded and presented by the Canadian Meteorological Society.
(b) A presentation of meteorological instruments to the Island Outdoor Natural Science School in Toronto.

This school brings in 72 grade six children from the Toronto area each week during the school year and provides classes dealing with Meteorology; Conservation; Farm, Bird and Pond life, etc. The children live on the Island during this period.

After discussions with the teacher responsible for presenting the meteorological portion of the program at the Island school, the Toronto Centre decided to support the acquisition of a psychrometer and a combined anemometer and wind direction indicator to be used in their program.

A number of calls have been received expressing interest in the seminar program but it was not possible to organize a course for this year due to late

timing. Hopefully, this portion of the program will become active during the next school year.

The 1973-74 executive is:

Chairman	-	P. G. Aber, Atmospheric Environment Service
Program Chairman	-	Dr. G. J. Boer, Atmospheric Environment Service
Secretary	-	V. S. Derco, Atmospheric Environment Service
Treasurer	-	W. A. Murray, MEP Company, Toronto.

OTTAWA CENTRE

For the 1973-74 Season of the Ottawa Centre, CMS, activities, the Executive was formed of the following:

Chairman	-	Mr. C. J. Stead Directorate of Meteorology & Oceanography Canadian Forces Weather Service
Vice-Chairman	-	Mr. D. G. McCormick Air Services Training School, AES
Secretary-Treasurer	-	Mr. A. P. Beaton Ice Forecasting Central, AES
Public Information	-	Mr. D. J. Webster Directorate of Meteorology & Oceanography Canadian Forces Weather Service

Prior to the commencement of the Season's sessions, a policy on the frequency of meetings and meeting location was formulated. Up to the time of writing, four meetings have been held, including the AES sponsored tour speaker.

On 26 Sept. 73, the 1973-74 season opened with a talk by Mr. J. MacDowall, Canada Centre for Remote Sensing, on the subject of "Applications of Remote Sensing". This talk was similar in scope to that given by Mr. MacDowall at the 7th Annual CMS Congress in Halifax held in mid-1973.

The next meeting on 28 Nov. 73 featured Mr. J. I. MacPherson who spoke about the high and low level turbulence research studies carried out by the National Aeronautical Establishment. The attendance at this meeting was fair, but the topic proved most interesting to all present.

The highlight of the 1973-74 Ottawa Centre program came in the New Year when, on 29 Jan. 74 at a dinner meeting attended by a mixed audience of 59, Mr. J. d'Avignon of the Metric Commission, Department of Industry, Trade and Commerce, presented a view into the future when, by 1980, all Canadians will be using metric units and thinking metrically. Mr. D'Avignon traced the history of the current concepts of weights and measures from antiquity to the present day, and expounded on the advantages of the metric system. He even implied that, for the forthcoming conversion to the metric system in Canada, a plastic overlay for the speedometer of a 1934 Maxwell could be made available, if necessary.

On 26 Feb. 74, the AES sponsored speaker, Dr. A. G. Davenport, Professor at the University of Western Ontario, spoke on the engineering applications of meteorology emphasizing the effect of strong winds on man-made structures. Although the attendance was not up to expectations, the talk, supported by explanatory slides, was most interesting and stimulating.

To round out the session, Mr. D. B. Kennedy, former Director Meteorology

& Oceanography, Canadian Forces Weather Service, will speak on "Technology in the Atmospheric Environment Service", a talk which should be of benefit to all those interested in the science of meteorology. Mr. Kennedy is a well-known figure throughout the meteorological service, and the Ottawa Centre is indeed fortunate to end its 1973-74 session with such a renowned meteorological personality.

A grant of $164, in accordance with the formula proposed by the National Executive in Nov. 1973, has been received by the Ottawa Centre, but as yet no firm plans have been made to utilize this donation in the furtherance of meteorology in the Ottawa area. However, it has proved most expedient in meeting administrative expenditures.

All meetings of the Ottawa Centre have been advertised liberally on radio, TV and newspaper by the Public Information Officer, but in spite of this special service, attendance at meetings continues to be a small fraction of the potential for the National Capital Region.

MONTREAL CENTRE

Past Chairman:	Dr. R. Douglas	McGill University
Chairman:	R. Robinson	Canadian Meteorological Centre, AES
Secretary:	Dr. G. Paulin	Université du Québec à Montréal
Treasurer:	C. Chouinard	McGill University

Five meetings of the Centre were held before April, with another two planned to take place before the season's end.

October 16 - Mr. Bernard Power, President, Weather Engineering of Canada
"Ice and Snow Accretion on Overhead Lines"

November 13 - Dr. Jan Rosinski, National Hail Research Experiment NCAR, Boulder, Colorado
"Atmospheric Aerosols in Cloud Physics"

December 11 - Dr. A. G. Davenport, Chairman, Civil Engineering Department, University of Western Ontario
"Strong Winds and Structures"

January 15 - Dr. E. J. Stansbury, Dean, Faculty of Science McGill University
"Lightning"

February 19 - Dr. A. Marsan, André Marsan et Associés Inc.
"Problèmes de la gestion de l'environnment"

April 16 - Dr. J. Padro, Research Directorate, AES, Toronto
"Boundary Layer Modelling"

May 14 - Dr. B. Michel, Department of Civil Engineering, Laval University
"Ice simulation in the St. Lawrence"

For many years, McGill University has generously provided lecture-hall facilities to the Centre. For its December and January meetings, however, the Centre returned to the more social atmosphere of the McGill Faculty Club, and in February extended its efforts to stimulate membership interest and

attendance by having a wine and cheese party in conjunction with Dr. Marsan's address.

The success of this last meeting, which saw a turnout of more than sixty members, wives, and friends, owed a special debt to Dr. Marsan, who consented on very short notice to substitute for the originally-scheduled speaker, Dr. Pierre Dansereau, when Dr. Dansereau became ill. The meeting was also the first one to be held at l'Université du Québec à Montréal by the Centre, and served to emphasize an increasing bond of interest and cooperation between the University and the Society.

CENTRE DE QUEBEC

Lors de son assemblée générale en mai 1974, la société de Météorologie de Québec fêtera son dixième anniversaire de fondation. Cet événement coincidera également avec la cinquième année d'affiliation du Centre de Québec à la Société météorologique du Canada. Voici un résumé des activités entreprises ou réalisées au cours de l'exercice 1973-74:

Le Bureau d'administration a tenu quatre réunions au cours desquelles ont abouti certaines réalisations dont voici les principales:

a) Révision et critique du dictionnaire des Sciences météorologiques de M. Gérard-J. Proulx; (Entrepris mais non terminé)

b) Formation d'un comité de Relations pour faire le lien entre le Centre de Québec et la Société météorologique du Canada;

c) Organization d'une tournée d'un conférencier spécialiste en météorologie, avec les constituantes de l'Université du Québec de Trois-Rivières, Rimouski et de Chicoutimi. Ce conférencier a été le docteur J.-P. Fortin de l'INRS de Québec qui a discuté des problèmes relatifs à l'évapotranspiration.

Au cours de cet exercice, sept réunions d'information publique ont été présentées, dont voici les conférenciers et les sujets, dans l'ordre chronologique:

9 octobre 1973:	Mr. Jim P. Bruce "Interaction of Meteorology and Water Resources Management".
13 novembre 1973:	Dr. Barney Boville "Le transport supersonique et ses conséquences sur l'atmosphère".
10 décembre 1973:	Dr. Roger Paquin "Résistance des plantes au froid et leur survie à l'hiver".
12 février 1974:	Dr. Pierre Dansereau "La mesure des impacts écologiques (prototype) d'une zone aéroportuaire".
19 mars 1974:	Dr. Svenn Orvig "Bilans thermique et hydrique avec exemple québécois".
9 avril 1974:	Dr. Alan G. Davenport "Strong Winds and Structures".
30 avril 1974:	Dr. Michel Cescas "Les sources potentielles de pollution en agriculture".

La plupart de ces réunions ont été tenues au département des Sols de l'université Laval grâce à la collaboration du Dr. Lawrence-J. O'Grady qui a mis un local à notre disposition.

Pour l'exercice qui prend fin, les registres de la SMQ comptent 61 membres. Le Conseil sortant se compose comme suit:

Président:	M. Raymond-M. Gagnon
Vice-Présidente:	Mlle Lise Robitaille
Conseillers:	MM. André Bentz Michel Ferland André Hufty Guy Lemelin
Secrétaire:	M. Gaétan Soucy
Trésorier:	M. Gaétan Soucy

NOTICE OF MOTION FROM COUNCIL

It is moved that the membership fees for 1975 be established as:

1. Member	$20
2. Student Member	5
3. Sustaining Member	60

REPORT OF NOMINATING COMMITTEE

The following names are submitted in nomination for Council for the year 1974-75. All nominees have been contacted and have given their consent to accept the Office if elected.

President	A. J. Robert
Vice-President	P. E. Merilees
Past President	W. F. Hitschfeld
Treasurer	I. N. Yacowar
Corresponding Secretary	H. L. Leighton
Recording Secretary	G. J. L. Paulin
Councillors-at-Large	A. F. McQuarrie R. H. Silversides C. V. Wilson
Auditor	R. D. Easto

Svenn Orvig
Chairman

MEMBERSHIP APPLICATION FORM

(Please write in Block Letters)

General or Student Member

SURNAME .....

GIVEN NAMES .....

PERMANENT ADDRESS .....

.....

TITLE, RANK, DECORATIONS, DEGREES OR PROFESSIONAL QUALIFICATIONS .....

.....

OCCUPATION .....
(for record purposes only; if student, indicate university and year studies will be completed)

Sustaining Member

NAME OR AGENCY .....

BUSINESS ADDRESS .....

.....

Membership Status Required

Please enroll me as a ..... member of the Canadian Meteorolocial Society effective January 1, 19 ....., to receive all publications issued by the Society from that date. I attach a cheque for $ ..... payable to the *Canadian Meteorological Society.*

Signature of Applicant

Mail completed application forms to:
Corresponding Secretary
Canadian Meteorological Society
P. O. Box 160
Ste-Anne de Bellevue PQ
H9X 3L5

CMS dues for 1974.

General Member	$15.00
Student Member	$ 5.00
Sustaining Member	$50.00 (min.)

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. At nine local centres of the Society, meetings are held on subjects of meteorological interest. *Atmosphere* as the scientific journal of the CMS is distributed free to all members. Each spring an annual congress is convened to serve as the National Meteorological Congress.

Correspondence regarding Society affairs should be directed to the Corresponding Secretary, Canadian Meteorological Society, P.O. Box 160, Ste-Anne-de-Bellevue, P.Q. H9X 3L5

There are three types of membership – Member, Student Member and Sustaining Member. For 1974 the dues are $15.00, $5.00 and $50.00 (min.), respectively. The annual Institutional subscription rate for *Atmosphere* is $10.00.

Correspondence relating to CMS membership or to institutional subscriptions should be directed to the University of Toronto Press, Journals Department, 5201 Dufferin St., Downsview, Ontario, Canada, M3H 5T8. Cheques should be made payable to the University of Toronto Press.

La Société météorologique du Canada a été fondée le 1er janvier 1967, en remplacement de la Division canadienne de la Société royale de météorologie, établie en 1940. Cette société existe pour le progrès de la météorologie et toute personne ou organisation qui s'intéresse à la météorologie peut en faire partie. Aux neuf centres locaux de la Société, on peut y faire des conférences sur divers sujets d'intérêt météorologique. *Atmosphère*, la revue scientifique de la SMC, est distribuée gratuitement à tous les membres. À chaque printemps, la Société organise un congrès qui sert de Congrès national de météorologie.

Toute correspondance concernant les activités de la Société devrait être adressée au Secrétaire-correspondant, Société météorologique du Canada, C.P. 160, Ste-Anne-de-Bellevue, P.Q. H9X 3L5

Il y a trois types de membres: Membre, Membre-étudiant, et Membre de soutien. La cotisation est, pour 1974, de $15.00, $5.00 et $50.00 (min.) respectivement. Les Institutions peuvent souscrire à *Atmosphère* au coût de $10.00 par année.

La correspondance concernant les souscriptions au SMC ou les souscriptions des institutions doit être envoyée aux Presses de l'Université de Toronto, Département des périodiques, 5201 Dufferin St., Downsview, Ontario, Canada, M3H 5T8. Les chèques doivent être payables aux Presses de l'Université de Toronto.

Council / Conseil d'Administration: 1973–74

President / Président	– W.F. Hitschfeld	*Councillors-at-large / Conseillers*
Vice-President / Vice-Président	– A.J. Robert	A.F. McQuarrie
Past President / Président sortant	– G.A. McKay	R.H. Silversides
Corresponding Secretary / Secrétaire-correspondant	– F.J. Lemire	C.V. Wilson
Treasurer / Trésorier	– I.N. Yacowar	*Chairmen of Local Centres / Présidents des centres*
Recording Secretary / Secrétaire d'assemblée	– J.F. Derome	

ATMOSPHERE

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	W. Gutzman	R.R. Rogers
	R. List	V.R. Turner
	C.L. Mateer	E.J. Truhlar
	G.A. McBean	E. Vowinckel
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