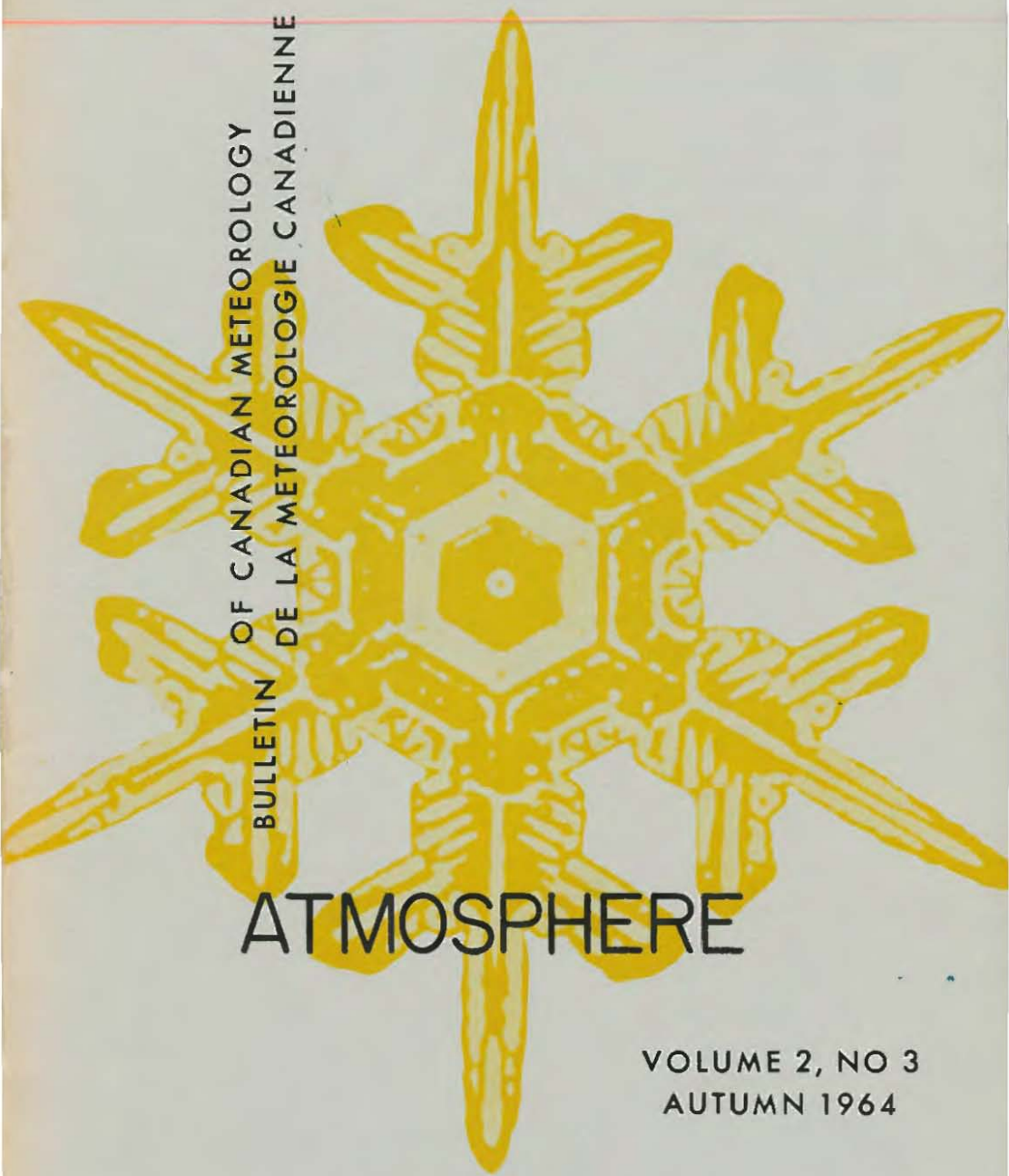

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ATMOSPHERE

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The Canadian Branch

ROYAL METEOROLOGICAL SOCIETY

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AN EDITORIAL

The meeting at Halifax this summer was a success. Several good papers were presented, and the discussion was useful. The meeting at Quebec last year was also successful. Hopefully, we look forward to better results this year than last, as far as manuscripts are concerned. Which is, a little more than a long silence.

Much interesting material was presented at these meetings, some of which could well have been made known to Canadian meteorologists through the pages of "Atmosphere".

We still think that there is enough activity in meteorological teaching, research, and practice in Canada to support a better publication than "Atmosphere" in its present form. With support from the Canadian Meteorological Fraternity it may yet happen.

And, speaking of activity in all phases of meteorology, Dr. W.L. Godson, this year's Buchan Prize winner, has been elected a Fellow of the Royal Society of Canada.

Congratulations!

EDITORIAL

La réunion tenue à Halifax l'été dernier fut des plus réussies. On y a présenté plusieurs communications intéressantes et les discussions qui suivirent s'avérèrent très fructueuses. La réunion tenue à Québec a été un franc succès. Nous avons bon espoir que nous nous surpasserons cette année et que plusieurs d'entre vous enverrez des manuscrits au bulletin.

A ces réunions on a présenté des communications qui auraient gagné à être diffusées à tous les météorologues canadiens par l'entremise de notre bulletin ATMOSPHERE.

Nous croyons sincèrement que les recherches, l'enseignement et toutes les activités qui se rapportent à la météorologie au Canada motivent en faveur d'une publication plus élaborée que le présent bulletin. Avec l'appui de tous nos collègues et techniciens à travers le pays, nous croyons que nous pouvons arriver à fonder une revue plus importante.

Nous sommes heureux de vous faire part de la nomination de M. le docteur W. L. Godson, lauréat du prix Buchan, à la Société Royale du Canada.

Nous lui offrons nos félicitations les plus chaleureuses!

A CHRISTMAS TREAT FOR METEOROLOGISTS

What better way to celebrate the holiday season and to recuperate from too much turkey and togetherness, than come to Montreal and attend the 131st AAAS Congress? Meetings and speeches galore: on history of science, parapsychology, nuclear physics, space (naturally), science education in schools and universities (to mention a few), and most relevantly, on METEOROLOGY.

The American Association for the Advancement of Science meets from 26 to 31 December 1964 at the Windsor and Queen Elizabeth Hotels in Montreal. Seventy-six scientific, professional and other "learned" societies participate. Details are in "Science", or can be obtained from the AAAS, 1515 Massachusetts Ave., N.W., Washington, D.C. 2005. Accommodation in Montreal is available at reduced rates through the AAAS Housing Bureau, 2055 Peel St., Suite 525, Montreal. Meteorologists will be interested in many of the sessions, but notably in the morning events of Monday and Tuesday, 28 and 29 December, which were arranged by the American Meteorological Society, the American Astronomical Society, and the Canadian Branch, Royal Meteorological Society. Both these meetings are uncrowded; they should be relaxing as well as informative: holiday fare, in fact. Both feature authorities from whom definitive answers to relevant questions can be expected!

POSSIBLE METEORIC OR LUNAR INFLUENCES ON METEOROLOGICAL PHENOMENA

Monday morning, 28 December, 9:00 a.m.-12:00

Windsor Hotel, Montreal

Chairman: Walter Orr ROBERTS, Director, NCAR

Main Papers, to present the positive case, as it stands today, with indications of possible mechanisms:

Meteoric dust and the weather: Keith C. BIGG, NCAR

The moon's phases and rainfall: Glenn BRIER, U.S. Weather Bureau

Comments:

Does the evidence stand up? Ralph SHAPIRO, Air Force Cambridge Research Laboratories

Relevant aerosol physics: Jan ROSINSKI, NCAR

Is radiation modulation a possible mechanism for either suggested phenomenon?: Verner SUOMI, University of Wisconsin

What to make of it all: Fred WHIPPLE, Harvard University

A METEOROLOGICAL SYMPOSIUM

Tuesday morning, 29 December, 9:00 a.m. - 12:00

Windsor Hotel, Montreal

Chairman: Walter HITSCHFELD, McGill University

Atmospheric radiation and dynamics: Richard M. GOODY, Harvard University

The advance of radar meteorology: J. Stewart MARSHALL, McGill University

Numerical weather prediction: Philip D. THOMPSON, National Center for Atmospheric Research; President, American Meteorological Society

These participants do not need special introduction to readers of "Atmosphere". But since the organizers cannot help boasting, they note: Professor Goody of St. John's College, Cambridge, and Imperial College, London, is Professor of Meteorology at Harvard and Director of the Blue Hill Observatory. In his talk to us, he is tying together the two major interests of his career: radiation and dynamics. It is not an easy subject, but it is near the centre of meteorology; how the heat sources in the atmosphere feed the dynamics, or how the dynamics transfers energy from the sources to the sinks. Dr. Goody is author of "Physics of the Stratosphere", a book which for years was a veritable vade mecum of scientists in this field; he has just published the first volume of a major series: "Atmospheric Radiation", a work which is likely to become a definitive statement on this subject for the 60's and 70's.

Professor Marshall, Director of the Stormy Weather Group and Macdonald Professor of Physics and Meteorology, was one of the first to recognize the revolutionary possibilities of radar for studying the weather. This subject has developed a long way, in no small measure due to J.S.M., from the days when rain clutter on radar scopes was, well, just clutter, to where most of our firm knowledge of storm dynamics and the morphology of convective and continuous precipitation is based on radar observations. Author of "Why the Weather" (C.B.C.) and of basic reviews on radar meteorology in "Advances of Geophysics" and "Meteorological Monographs". Popular lecturer.

Philip D. Thompson is Associate Director of the National Center for Atmospheric Research. His recent election to the Presidency of the A.M.S. is the culmination of many fruitful years of work for that society. Author of the highly praised "Numerical Weather Analysis and Prediction" (1961), he has written on many aspects of turbulence, NWP, and dynamic meteorology. Before taking up his duties at NCAR, he was a Colonel in the USAF, worked at UCLA, directed the numerical prediction project of the GRD-Air Weather Service, and taught at the University of Stockholm.

FIFTH NATIONAL CONGRESS OF THE CANADIAN BRANCH OF THE ROYAL METEOROLOGICAL SOCIETY

For the fifth year in succession the Canadian Branch joined the Learned Societies in their annual meetings which conclude the academic year in Canadian Universities. On this occasion Halifax was the venue. Distance from the main centres of population in Canada did not appreciably affect the attendance - there were 65 registrations - but in contrast with the sunny skies of previous locations, Halifax will be remembered for its wind and rain and 40 degree temperatures. Meetings were held on two days, 11th and 12th June, in the Sir James Dunn Science Building, Dalhousie University and in the Chemistry Building.

The chairman of the Programme Committee was H.M. Hutchon. Nineteen papers were read in all, the first day being a "University day", the second a "Meteorological Service day".

Local arrangements were in the hands of Lyall Swansburg.

FIRST DAY - Morning Session

Prof. B.W. Boville, McGill University, retiring President of the Branch, took the chair for the first session, which was held jointly with the Canadian Association of Physicists. His own work on the general circulation formed the first subject. Prof. Boville opened with an historical introduction and a general statement of the three main aspects of the problem as they appear today. These were then dealt with in detail by members of his group. Using a series of colour slides Mr. B. O'Reilly summarized the methods of exchange of energy from available potential to kinetic and back and between the various types of kinetic energy, e.g. that contained in meridional motion, the zonal current and in the stationary and travelling eddies - cyclones. He emphasized that it is the synoptic scale eddies which play the predominant part in the conversion of potential energy into air motion - sending energy up the spectrum to maintain the zonal current and planetary waves and down the spectrum into turbulent and frictional dissipation. Mr. Andre Robert dealt with the effects of convection and heat transfer in the meridional circulation and suggested that the interactions between eddies on different scales was a feature of importance. Mr. Merilees showed that the effects of non-linear interaction had been seriously underestimated in the past and that non-linear wave growth required careful investigation. He presented graphs showing the growth of a wave at the expense of the zonal flow. Linear growth was shown to proceed without limit while non-linear growth ends after most of the available energy has been taken out of the flow. The stabilization of the long waves by the short waves was also discussed.

Papers by Mr. C. Quon of the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, and Prof. A.W. Brewer, Toronto University, were then taken up. Mr. Quon explained the problems facing a wave forecaster, who is handicapped by lack of observations and who must forecast such an erratic element as wave height, dependent on such diverse factors as the air-sea temperature difference, air turbulence, the angle of the wind direction to the running sea, in addition to depth and fetch. Wave refraction is of particular importance in coastal waters because of the rapid change in depth: this was illustrated by slides showing two wave trains entering the Gulf of St. Lawrence: although coming from the same direction a moderate difference in wave-length produces markedly different travel in the Gulf. Prof. Brewer described a new technique for the measurement of ozone in the stratosphere. The platinum element was baked: the sonde is launched so that one radiometer is so close below the balloon that it is constantly in its shadow and a second so far beneath that it is clear. It was possible to obtain the ratio between direct and scattered radiation. The technique could be particularly successful in the tropics and three ascents made in Jamaica this spring had given entirely compatible results.

Afternoon Session.

The afternoon session carried the title "Physical and Dynamical Meteorology" and was under the chairmanship of Dr. D.P. McIntyre, a past President of the Branch.

Two papers were presented by members of Prof. Orvig's McGill Arctic Group. Miss Bea Taylor was concerned with evaporation and sensible heat flux over the Arctic Ocean. Her tables and graphs indicated that both these elements are very sensitive to the amount of open water and, in fact, that there is not enough energy available to maintain the fluxes if substantially greater areas of open sea were to exist. In spite of this the studies indicated that the Arctic sea ice is becoming progressively thinner, a result confirmed by a comparison of current values of the ice thickness with those made at the end of the nineteenth century. Prof. Orvig then went into the question of the heat budget over the Arctic Ocean: this had been investigated for the surface, the troposphere and the earth-atmosphere as a whole. It emerged that in the approach to the studies a cloud atlas had been prepared which gave average type and amount of cloud for each month of the year for different regions of the Arctic. The predominance of longwave radiation towards the surface is far more significant in the Arctic than in other latitudes. A substantial portion of the incoming radiation energy in summer is put into storage by absorption in the water and by warming and melting of ice. In the case of the tropospheric budget the importance of the non-radiative terms increases for the incoming side of the budget and decreases on the expenditure side, where radiation becomes practically the only term. In the case of the earth-atmosphere system as a whole the absorbed solar radiation is proportionally smaller in the north and the contribution of evaporation to the energy turn-over is also less than the global average. Dr. J. Maybank of the Saskatchewan Research Council had been investigating Bowen correlations in respect of rainfall in the Canadian prairies. Reasonably good agreement had been found but time intervals other than the 30-day period appeared to give equally good results. Dr. Maybank was attempting to link the precipitation anomalies with pressure cycles dependent on extra-terrestrial influences. Mr. J. Derome, McGill University, in a study of the relationship of large scale vertical motion with the occurrence of severe storms, in a week in May, 1961, in eastern North America, had found a good correlation with morning precipitation only.

SECOND DAY - Morning Session

On the second day Mr. J.M. Leaver, a past President of the Branch, was in the chair for a session of six papers on synop-

tic analysis and prediction, contributed by staff members of the Canadian Meteorological Service.

Mr. R.A. Hornstein, chief forecaster of the Atlantic Weather Central, this year a winner of a Patterson Medal, reviewed the weather of the past winter in the Maritime Provinces of Canada. This was a period of exceptional cyclonic activity in the area: taking as a measure of "explosive deepening" Gen. J.J. George's criterion given in his book "Weather Forecasting for Aeronautics", of a central pressure fall of 20 mb in 24 hrs, this one winter had provided as many such storms as noted by George in the three-year period studied by him. Mr. E.C. Jarvis of the Research Section, had been working on a refinement of the Wilson grid method of forecasting displacement by the introduction of standard monthly sea surface temperatures. The remainder of the session was taken up by work from the Central Analysis Office. Mr. D.E. Page described a quick method for the prediction of precipitation two days in advance. Prognostic thickness patterns for the layer 1000 - 700 mb, prepared in 24-hr time steps, are superimposed on the NWP prognostic 500 mb vorticity chart. In less than a quarter of an hour a diagnosis can be made of the amount of development and vertical motion to be expected and therefrom an evaluation of rates of precipitation. Mr. D. Davies reported on attempts to improve the routine computer prognoses by "patching", i.e., carrying out secondary calculations in regions of strong activity. Unfortunately the patching has to be done before the integration of the equations, necessitating the introduction of more complicated methods of relaxation. Mr. R. Asselin reviewed work on the elimination of spurious anticyclogenesis persisting despite improved objective analysis . The use of the complete balance equation in place of the linearized form met requirements, apparently due to an improved estimate of wind speeds in the troughs. Mr. W.S. Creswick described the many pitfalls resulting from the introduction into the computer of estimated data in the silent areas of the chart.

Afternoon Session

The incoming President, Dr. R.E. Munn, of the Meteorological Service, was in the chair for the final session.

Prof. Hitschfeld read a paper by R.C. Srivastava of McGill University, who was putting forward a numerical model of cumulus convection which could take care of both the jet and bubble theories of cloud growth. The initial radius of the jet is found to be an important parameter. Criticism of the jet-cum-entrainment mechanism has often been based on the assumption that the weight of condensed water would kill the jet. However, Mr. Srivastava finds that concentrations as high as 10 gm/m^3 can occur with only a small reduction of jet speed.

The author hopes to continue this investigation by considering the effect of a partially mixed collar between the rising jet and the ambient air. Members of the Meteorological Service made up the balance of the session. Mr. U. Sporns reported on a major cooperative study of flood flows being conducted on a joint basis with the federal Water Resources Branch and the Nova Scotia Power Commission. The work was so far forward that it was considered that a reliable estimate could be given of the probability of any given rainfall over any of the river valleys in the province. Mr. H.J. Wilson had been investigating pollution at Saint John, New Brunswick; he also read a paper by H.F. Cork on low level inversions near Lake Erie, where two types had been found. One, occurring on clear nights with light winds, persisted for about 12 hours: the other, on cloudy nights with strong winds, for less than half as long. The Chairman and President then took up the first of two papers from the Suffield Experimental Station, Alberta. Some 20 years ago, as part of a radio-wave propagation study, hourly vertical profiles of temperature and mixing ratio had been obtained at 10-foot intervals from a 100-foot tower. As vertical profiles of humidity are relatively rare in the lowest 100 feet of the atmosphere, these had been worked up and it had been possible to infer the relative contributions of ~~relative~~ radiative and turbulent flux divergence in determining the diurnal temperature cycle. In the final paper Mr. O. Johnson summarized experiments to measure the concentration of smoke up to about 15 km from the source. The trials were made at night and it had been found that where the conditions were slightly unstable agreement with standard diffusion theory was better: where the conditions were stable concentrations at ranges above about 3 km were less than predicted.

In a large country like Canada not the least fringe benefit of these Congresses is the opportunity they afford for a meeting of meteorologists who would otherwise never get together. A notable regular attender in his retirement is Dr. Andrew Thomson, a former Director of the Meteorological Service. Fellows, who gathered for luncheon at the Lord Nelson Hotel on the first day, enjoyed the hospitality of a reception by Dalhousie and a trip across the harbour to the National Oceanographic Institute as its guests. Next year Fellows will experience the "coast to coast" nature of the country when the Learned Societies gather at Vancouver.

J.A. McCallum

REPORTS FROM CENTRES

Toronto Centre

February 1964:

Use of computers in operational meteorology in Canada was outlined at the February meeting of the Toronto Centre with an audience of 60 and a high level of interest. Mr. J. Leaver outlined briefly the events leading up to the introduction of computer techniques at the Central Analysis Office. During the 1950's there was a growing realization of the need for automation, both to handle the increasing volume of data and to permit the development of more elaborate and objective forecasting procedures. Considerable development work in numerical forecasting was carried out on medium-scale computers available in the Montreal area. In the latter part of 1962 the Central Analysis Office installed a Bendix (now Control Data) G-20 computer with 8192 words of core storage, 6 magnetic tape units, a control buffer, card and paper tape units and a high-speed printer. Programs have been developed to extract and check incoming data, to prepare objective analyses, to produce contour maps, to extrapolate the 500-mb flow pattern by means of a barotropic prediction model, and to derive high level forecasts from 500-mb prognoses. A baroclinic prediction model is under development.

Details were outlined of three phases of the program which limit its present speed. These referred to the deteriorating situation with regard to time of receipt of data, the transformation of the computer output into chart form, and finally the transmission of the charts to field offices.

These three constrictions in the flow of work now limit the program. Data receipt is, of course, a problem in national and international communications receiving continuing consideration, but Mr. Leaver raised the question of whether a meteorological service should examine the need for multiple charts in the field, and whether other forms and methods might not be used for getting out and transmitting analysed and forecast fields. These might include photographic reproduction of cathode ray tube displays of fields contained in memory, devices in field offices or weather centrals for graphing in chart form grid point arrays transmitted at high speed and collected on magnetic tape by the receiving station, the presentation of some forecast fields (e.g., upper winds and temperatures in grid point form), etc. A lively question and discussion period followed Mr. Leaver's presentation.

F.B.M.

March 1964:

Prediction in general was discussed in many of its fundamental aspects at the March meeting of the Toronto Centre, by a panel of seven authoritative representatives of disciplines and professions concerned with prediction.

The following served on the panel:

A.R. McCracken, Actuary (Vice-President, North American Life Assurance Co.); W.A. Beckett, Economist (W.A. Beckett Associates); Prof. Derek York, Geophysicist (University of Toronto); J.B. McGeachy, Political commentator (Associate Editor, The Financial Post); Prof. B.J. Quarrington, Psychiatrist (University of Toronto); M. Montgomery, Barrister; C.M. Penner, Meteorologist, Superintendent of Training, Canadian Meteorological Service. The Moderator was Percy Saltzman, Meteorologist and well known TV personality.

The aspects examined included:

Triviality and usefulness of prediction; predictions with feedback, such as economic or behavioral prediction; dispassionate prediction of a scientist to test an hypothesis or theory; prediction of average events as opposed to individual; guessing compared with prediction; prediction from physical laws as opposed to prediction by the use of time lag relations with empirical predictors; need for verification in serious prediction; prediction of runs of luck; elementary techniques in prediction such as persistence, projection.

The panel discussion, guided expertly by Moderator Saltzman, maintained good pace and interest, but the experience suggested that better audience participation might be accomplished if the audience and panel are in closer contact, as with a circular or semi-circular seating arrangement. A recording on tape will be available to any interested groups.

F.B.M.

September 1964:

The first meeting of the Toronto Centre of the Royal Meteorological Society for the 1964-65 season was held on September 23 at 175 Bedford Road, with Dr. W.C. Swinbank of the Division of Meteorological Physics, C.S.I.R.O., Aspendale, Australia, speaking on the topic "The Wind Profile with Thermal Stratification".

An enthusiastic audience of 65 turned out to hear this very interesting and polished speaker, and as observed by Dr. Brewer in his remarks of appreciation which concluded the evening, "Everyone stayed for the discussion".

Dr. Swinbank presented his method and solution of the problem of determining the relationship between the vertical wind shear and the rate of vertical heat exchange, the shearing stress and the height, when the air is thermally stratified. Previous attempts to solve this problem had been mostly empirical because of the severe difficulties involved in finding a theoretical solution. In his new theoretical approach, described by Dr. Swinbank as a trick, he showed how replacing the height variable by a new variable to make the relation between the wind and the log of the new height variable linear regardless of the stability of the air led to a relatively easy solution. He then proceeded to demonstrate, by the results of a series of experimental investigations conducted in Australia, that the theoretical solution depicts very accurately the conditions which exist in nature, thereby providing justification of the method. Dr. Swinbank concluded his talk by showing that his theoretical treatment and experimental investigation confirm heat transfer and momentum transfer mechanisms in the atmosphere to be different, a difference which he attributed to buoyancy and showed to be dependent on the degree of instability of the air.

After a brief refreshment break, the meeting was concluded by a lively discussion period.

J.D.H.

Montreal Centre

March 19, 1964:

For its sixth meeting of the session, held as usual in the Physics Building at McGill University under the chairmanship of Professor W. Hitschfeld, the Centre was privileged to listen to another account of original work in a kindred discipline. On this occasion it was given by Prof. J.B. Bird of the Department of Geography at McGill.

Professor Bird's research group had copies of many of the N.A.S.A. (U.S.A.) satellite photographs and were endeavouring to produce from them detailed maps of land forms and land utilisation, which are not generally available for even as developed a country as

Canada. Aerial photography has made immense strides in the past decade, and with the new material Professor Bird indicated that it was now possible to realise the geographers' dream of land utilisation maps on a scale of 1:250,000. These maps would be invaluable for planning of the further development of natural resources.

Photographic film recovered from rocket or satellite flights provide, in general, much more detail than TV-type pictures relayed to earth from high-flying satellites. In the case of non-orbital rocket flights, recovery was relatively simple but the photographs were restricted to areas in proximity to the launching pads. Photography of the entire surface of the earth was possible by satellite, but recovery of the film was a delicate operation, involving retro-rocket firing carefully controlled to achieve descent into a designated target patrolled by surface vessels and aircraft.

Professor Bird showed a number of satellite pictures. The Persian Gulf and the Nile Valley were recognisable to the uninitiated, but what was identified as the Sahara was transversed by what looked remarkably like the Great Wall of China. It was clear that if there was one thing that offended Professor Bird on a satellite picture, it was clouds. However, he held out hopes to the meteorologists that cloud-free pictures would contribute to sea-ice forecasting, determination of surface albedo and snow cover, and to the detection of forest fires.

Fellows expressed great interest in what Professor Bird had discussed: the meeting was memorable in a session which has been noted for the diversity and originality of work presented in the field of geophysics as a whole.

P.C.
J.L.G.

April 30, 1964:

Dr. Hitschfeld introduced the speaker of the evening, Mr. P.W. Summers, whose topic was "Air Pollution in Montreal, an Urban Ventilation Model". Mr. Sumers has been working on the problem of air pollution in Montreal for the past 4 years, and has previously given progress reports at various meetings of the Canadian Branch. On this occasion Mr. Summers summarized his previous findings and presented the final results of his investigation.

Throughout his study Mr. Summers made use of 3 soiling index samplers, 2 situated within the business section of Montreal and

a third on the CBC TV towers on the mountain in the centre of the city, supplemented by movable samplers. As indications of conditions outside the city, he used the weather reports of St. Hubert and of Macdonald College at Ste. Anne de Bellevue. The soiling index samplers used, while only measuring particulate matter, have the advantage that they collect very many sorts of pollution and are therefore better for the study of an area source such as a city, while a sampler of a specific pollutant would give more detailed information concerning a particular point source. However, the very fact that one is concerned with an area source adds a theoretical difficulty, in that diffusion theory has not been developed for this case.

Graphs were shown of the average annual, weekly and daily cycles of pollution. From these it was possible to make reasonable estimates of the contribution made to total pollution by industry, by traffic and by household heating. In Montreal during the winter, about half of all pollution appears to be caused by the heating of buildings.

A sharp rise of pollution index near sunrise has been shown in most similar studies. This has normally been attributed to "Hewson fumigation". However, the very high rate of pollution at Montreal has allowed a finer resolution of the time scale than has been possible elsewhere, and Mr. Summers has shown that this rise occurs about an hour before sunrise, and may consequently be regarded as resulting from human activities rather than being a natural phenomenon. Similarly, Mr. Summers regards the sharp peak near midnight as being due to apartment house incinerators which are normally used in the late evening.

Mr. Summers developed the Mixing Depth Theory. Due to the addition of heat by the city itself an undisturbed lapse rate never exists over it, nor does a nocturnal inversion. (It should be noted that the heat production due to fuel consumption within the city amounts to some 18 percent of the total incoming solar radiation within the area, a far from negligible quantity.) There is, rather, a layer of polluted air whose height rises parabolically across the city from zero on the windward side to a maximum on the leeward side. A small lapse rate occurs in this layer with the steeper lapse rate of country air above it. Commonly, in Montreal, the layer is six to eight hundred feet thick and has its upper limit near the top of the recently built sky-scraper complexes, which therefore form a handy yardstick for measuring the depth of the layer.

The height of the layer is a function, principally, of the rate of heat production by the city and of the wind speed, with other factors such as the temperature and lapse rate of the incoming unpolluted air.

A lively question period followed the presentation of the paper. Some of the questioners evidenced envy of the speaker, who is shortly to leave the murk of Montreal for the clean dry air of Alberta.

J.A. McCallum

May 19, 1964:

The eighth and final meeting of the 1963-64 season was held in the Physics Building, McGill University, on Tuesday, May 19th, 1964. The guest speaker was Professor Aksel Wiin-Nielsen of the University of Michigan, who spoke on: "Energy and energy transformations in the atmosphere - some new results". Professor Wiin-Nielsen reviewed the history of the study of energy and energy transformations in the atmosphere. He then gave, with considerable reference to block diagrams drawn on the blackboard, an account of recent quantitative investigations on the subject.

Currently, it has become customary to discuss energy and energy transformations in terms of zonal and eddy components of both available potential and kinetic energy, and the exchange rates between them. Recent simple actual estimates of these quantities have been obtained by Wiin-Nielsen; Saltzman and Fleischer; Krueger, Winston, and Haines; and White and Saltzman. The thermodynamic equation was used by Wiin-Nielsen to obtain vertical velocities. The only estimate of frictional dissipation was done by Brunt in 1926. The "residence time" associated with a particular form of energy is a rough indication of how long energy is retained in that form. In the troposphere averages of these estimates are, for energy in winter in units of kilojoules/sq. metre, with residence times in brackets:

Zonal available potential energy	-	3800 (12 days);
Zonal kinetic energy	-	1100 (142 days);
Eddy available potential energy	-	1100 (4 days);
Eddy kinetic energy	-	1700 (8 days).

For energy transformations in winter in units of 10^{-4} kilojoule/sq. metre/sec:

Zonal diabatic heating	-	31;
Eddy diabatic heating	-	-14;
Zonal A.P.E. $\longrightarrow$ Eddy A.P.E.	-	36;
Zonal K.E. $\longrightarrow$ Zonal A.P.E.	-	1.3;
Eddy A.P.E. $\longrightarrow$ Eddy K.E.	-	25.5;
Eddy K.E. $\longrightarrow$ Zonal K.E.	-	2.4;
Frictional Dissipation of K.E.	-	51;

Summer values of energies and energy transformations are 1/2 to 2/3 the winter ones; except for transformations from eddy kinetic energy to zonal kinetic energy, and zonal kinetic energy to zonal available potential energy, which seem to be two or three times larger in summer than in winter. Recently the kinetic energy has been further subdivided into the vertical mean and the deviation from the vertical mean. One reason barotropic forecasts are so good as they are is that they essentially work with the vertical mean. Oort has recently done similar evaluations for the stratosphere; he found that energy transformations are one or two orders of magnitude smaller than in the troposphere.

Opening the discussion the chairman, Mr. W. Creswick, expressed surprise at the comparatively small magnitudes of the transformations to and from zonal kinetic energy; and suggested that they might be only net magnitudes. Mr. A. Robert asked how the zonal flow fluctuates from week to week. Professor Wiin-Nielsen answered that the total energy remains constant although individual jet streams may drift north and south. Professor B. Boville questioned the degree of reliability of the results by pointing out that effectively only half the mass of the hemisphere had been adequately treated; and that much of the energy source was in the omitted tropical regions. Professor Wiin-Nielsen agreed that only one-quarter of the whole atmosphere had been considered; and pointed out the difficulties of using balanced or geostrophic winds in the tropics. But while affirming interest in extending the calculations to the southern hemisphere, and to the tropics using real winds, Professor Wiin-Nielsen said that he did not expect to find any systematic differences in the directions of the energy transformations. Professor Boville asked if mountains dissipate kinetic energy; and if it was possible to do a simple analysis of frictional dissipation. Professor Wiin-Nielsen answered that mountains create forced motion, but that it is not yet known how the forced motion propagates upward through the atmosphere; and that it should be possible to do some calculations of frictional dissipation using the friction layer alone, and thus compute the con-

tribution from the lower level. The discussion ended with a few more detailed comments on frictional dissipation.

D. Davies

ANNUAL MEETING

Montreal Centre

The Annual General Meeting of the Montreal Centre took place in the Physics Building of McGill University on the evening of April 30th with approximately 35 members present. Dr. W. Hitschfeld, Chairman of the Centre during 1963-64, briefly presented the Secretary's report which had been previously distributed by mail. Seven sessions of the Centre had been held during the tenure of office of the current executive. The Treasurer's report showed a small, though welcome, increase in assets. The following slate of officers was proposed for the year 1964-65:

Chairman	W.S. Creswick, Centr. Analysis Office
Secretary	P.E. Merilees, McGill University
Treasurer	G. Moody, Main Meteorological Office
Member	W.L. Gutzman, Centr. Analysis Office

There being no other nominations, Dr. Hitschfeld declared the proposed slate elected with tenure of office beginning May 1st.

Montreal Centre

September 10, 1964:

The 1964-65 session was opened in the Physics Building of McGill University with Mr. W.S. Creswick of the Central Analysis Office of the national meteorological service in the chair. The speaker was Dr. Richard S. Lindzen of Harvard University division of engineering and applied physics who discussed non-adiabatic influences in stability problems.

Dr. Lindzen considered that neglect of viscosity or of non-adiabatic processes in classical turbulence and stability theories frequently led to results contrary to observation. As an illustration he described a hypothetical experiment in which a balloon, with mean position at the interface between a cold lower and a warm

upper layer, was held by a spring. This was obviously a stable configuration under adiabatic conditions, but if the balloon was permitted to exchange heat with its surroundings its oscillations would increase in amplitude with time.

Calculations he had made on the stability of atmospheric motions, in which the radiation terms for ozone and carbon dioxide had been included, had pointed to the possibility of unstable waves of long period. Dr. Lindzen considered that radiation played a part in the maintenance of the 26-month cycle although it was probably not the basic cause of this phenomenon.

W.S.C.

September 29, 1964:

Paul M. Hamilton was the speaker at the second meeting of the 1964-65 session, held in the Physics Building of McGill University, with Mr. W.S. Creswick in the chair. His subject was "Vertical Profiles of Total Precipitation" on which he had completed his thesis for the Ph.D degree he had received on the previous day from McGill. Dr. Hamilton, who was leaving for the United Kingdom on the following day to take up an appointment with the British Electricity Authority, said that his work was a contribution to the steady development in the application of radar techniques to the observing of precipitation that had been taking place at McGill.

He had been able to obtain profiles of the total precipitation on total flux from measurements at every 5,000 feet level at 22-minute time intervals. He had found that the profiles could broadly be classified into families. Profiles characteristic of heavy showers showed peaks of maximum accumulation of rain at levels near 25,000 - 30,000 feet. Cases typical of moderate showers showed peaks around 12-20,000 feet. Continuous rain showed no peaks but just a steady decrease from the top of the precipitation to the ground. A linear relationship appeared to exist between the level of the maximum accumulation of rain and the positive convective energy area computed from the tephigram. By allowing for the loading effect experienced by an updraft due to the weight of accumulated rain and liquid water Dr. Hamilton had been able to get the straight line to pass through the origin. There had to be at least 0.8 joules per gram of positive energy available in order for peaking to occur. He quoted the work of East and Kessler to show that the mean updraft speed was related directly to the level of maximum accumulation of rain shown by the profiles.

A case study of the development of the profiles throughout

the life of a storm (2 July 1963) was taken up. A well-developed line of precipitation with peak initially at high levels moved over the Montreal area from the northwest, dissipated over the St. Lawrence valley and then reformed on the American side with peak again at high level. During the dissipation stage an increase in rainfall intensity from 0.5 to 1.5 ins/hr was noted at Hawkesbury. Other cases of severe weather occurring as the level of maximum accumulation of rain passed downward through the 12,000 foot level were also noted. Dr. Hamilton showed that the most likely reason for the dissipation of the line of rain was the influx of air with lower pseudo wet-bulb temperature (lower by 2°C) into the storm.

A lively discussion followed the talk with numerous questions from the considerable audience. Dr. Hamilton thought that his work might have practical applications in very short range severe weather forecasting, but a computer would probably have to be combined with the radar equipment to provide rapid availability of the profiles.

J. Simla

WINNIPEG Centre

The Winnipeg Centre held four meetings during the first half of 1964: on 31 January, with Mr. G. McKay speaking on "Watershed Resources in Western Canada"; on 17 April, with a panel discussing Weather Radar (the Panel consisting of Messrs. Pincock, Crosby, Zawatsky and Johnson); on 30 May (a Social Evening); and on 16 June - a Dinner Meeting with Dr. J. Maybank of the Saskatchewan Research Council speaking on theories and mechanisms for lightning discharges in thunderstorms.

W. D. Gilmour

Secretary - Treasurer

U.B.C. HOSTS A.A.A.S. MEETINGS

The University of B.C. at Vancouver hosted one of the largest scientific meetings ever held in western Canada June 22 to 27 when the Pacific Division of the American Association for the Advancement of Science met on the Point Grey campus.

The Association is made up of more than fifty-five affiliated societies and associations, and twelve of these, including the American Meteorological Society, the western division of the American Society of Ichthyologists and Herpetologists, the Pacific Division of the American Society of Limnology and Oceanography, and the Western Society of Soil Science, held annual meetings during the week.

More than one thousand scientists from Canada and the United States took part in the forty-fifth annual meeting of the association, which last met in Vancouver in 1949.

The American Meteorological Society meetings spanned a full two and a half days, and guest speakers from Canada and the United States presented a number of very interesting and informative papers. A complete summary of the papers was given in the Bulletin of the American Meteorological Society, Volume 45 Number 4 for April, 1964. Hence only a brief mention of some of the highlights of the meetings is given here.

Dr. Bernhard Haurwitz, of the University of Colorado, formerly of the Canadian Meteorological Service, presented his paper on "The Present State and Unsolved Problems of Tidal Theory - A Review". He remarked in his introduction that he had nothing new to report, but that he did not let this stop him.

Mr. Richmond W. Longley, of the University of Alberta, formerly of the Meteorological Service of Canada, presented an unscheduled paper on "Minimum Temperatures North of the Arctic Circle". Graphs were used to show that temperatures underwent a rapid decrease during November and December, followed by a slower decrease during January and February, to arrive at a minimum value in late February. Subsequent warming began slowly in March and accelerated through April.

Dr. E.R. Walker, of Suffield, and Mr. W. Harley, of Head Office, carried on the honour of the Canadian Weather Service with papers based on work presently being undertaken by them.

Dr. P.D. McTaggart-Cowan, former Director of the Canadian Meteorological Service, and now president of Simon Fraser University of B.C., was guest speaker to about sixty delegates during a luncheon at the local U.B.C. graduate centre. He outlined the increasing demands for meteorological information, and felt there was an exciting future ahead in meteorology. He emphasized the need for the Canadian Weather Service and the Universities to work together, and the importance of providing freedom for real research. He pointed out that some investigators need a

definite goal before them to provide the incentive, but that there are a few, and only a few in any generation, who should be provided with the means and the freedom to branch out on their own.

Mr. A.R. McCauley, regional meteorologist at Vancouver, chaired the Wednesday Morning session. He handled his duties with dispatch, and in spite of the tendency on the part of some speakers to extend beyond the allotted time, he was able to bring to a close a very worthwhile, interesting, and practical session.

In all, the two and a half days of meetings and discussions turned out extremely well. Opportunity was provided for meeting and conversing with a number of the outstanding men in the field. Mutual problems were discovered and discussed. Also, for once, the local weathermen cooperated and provided suitably fine weather for the event.

J.B. Wright

FIRST CANADIAN CONFERENCE ON MICRO-METEOROLOGY

April 12-14, 1965, Toronto, Ont.

The First Canadian Conference on Micrometeorology will take place April 12-14, 1965 in Toronto. The sponsor is the Meteorological Subcommittee of the National Research Council Associate Committee on Geodesy and Geophysics.

Three distinguished micrometeorologists from other countries who have accepted invitations to attend are:

Professor H. Panofsky, Department of Meteorology, Pennsylvania State University, author of the recent book, "The Structure of Atmospheric Turbulence."

Dr. F. Pasquill, Meteorological Office, Bracknell, England, author of the recent book, "Atmospheric Diffusion".

Professor G. Gill, Department of Meteorology and Oceanography, University of Michigan, a widely recognized authority on micrometeorological instruments.

A feature of interest will be an evening meeting of the Toronto Centre of the Royal Meteorological Society at which there will be a symposium, "The Climate of Cities", arranged by Mr. M.K. Thomas. It is also hoped to have an informal dinner on one other evening.

PRELIMINARY ANNOUNCEMENT

International Symposium on Design of Hydrometeorological Networks

Sponsored by World Meteorological Organization (WMO) and International Association of Scientific Hydrology (IASH)

Laval University, Quebec City, P.Q., Canada

June 15-22, 1965.

In some parts of the world networks to observe stream flow, precipitation and other parameters in the hydrologic cycle are just being planned as part of the International Hydrologic Decade programme. In other areas, highly developed dense networks have been in operation for a number of years. This international symposium is planned to assist in ensuring optimum design of networks in both types of areas. Topics to be discussed include: objectives of hydrometeorological networks; basic principles of network design for precipitation; snow cover, water levels and stream flow; water chemistry, sediment transport; ground water, soil moisture and evaporation; effects of new instrumentation on network design for each of these parameters; co-ordinated network planning; special problem areas such as arid zones, humid tropics, polar and mountainous regions and organization of data gathering services. A number of the world's outstanding experts will be preparing "keynote" papers on these subjects, which will be distributed (in English and French) in advance of the conference to all pre-registered delegates. Non-invited and discussion papers are encouraged and ample opportunity will be given for free discussion. Authors wishing to submit papers for the symposium are invited to send title and abstract to Prof. L.J. Tison, Secretary General of IASH, Braamstraat 61, (Rue des Ronces), Gentbrugge, Belgium. Low priced accommodation in a new students' residence on the Laval University campus will be available. Pre-registration forms and more detailed information will be distributed with a future issue of the IASH Bulletin and the WMO Bulletin, or can be obtained from Mr. Michel Slivitzky, Director - Hydrological Services, Department of Natural Resources, Quebec City, Que., Canada.