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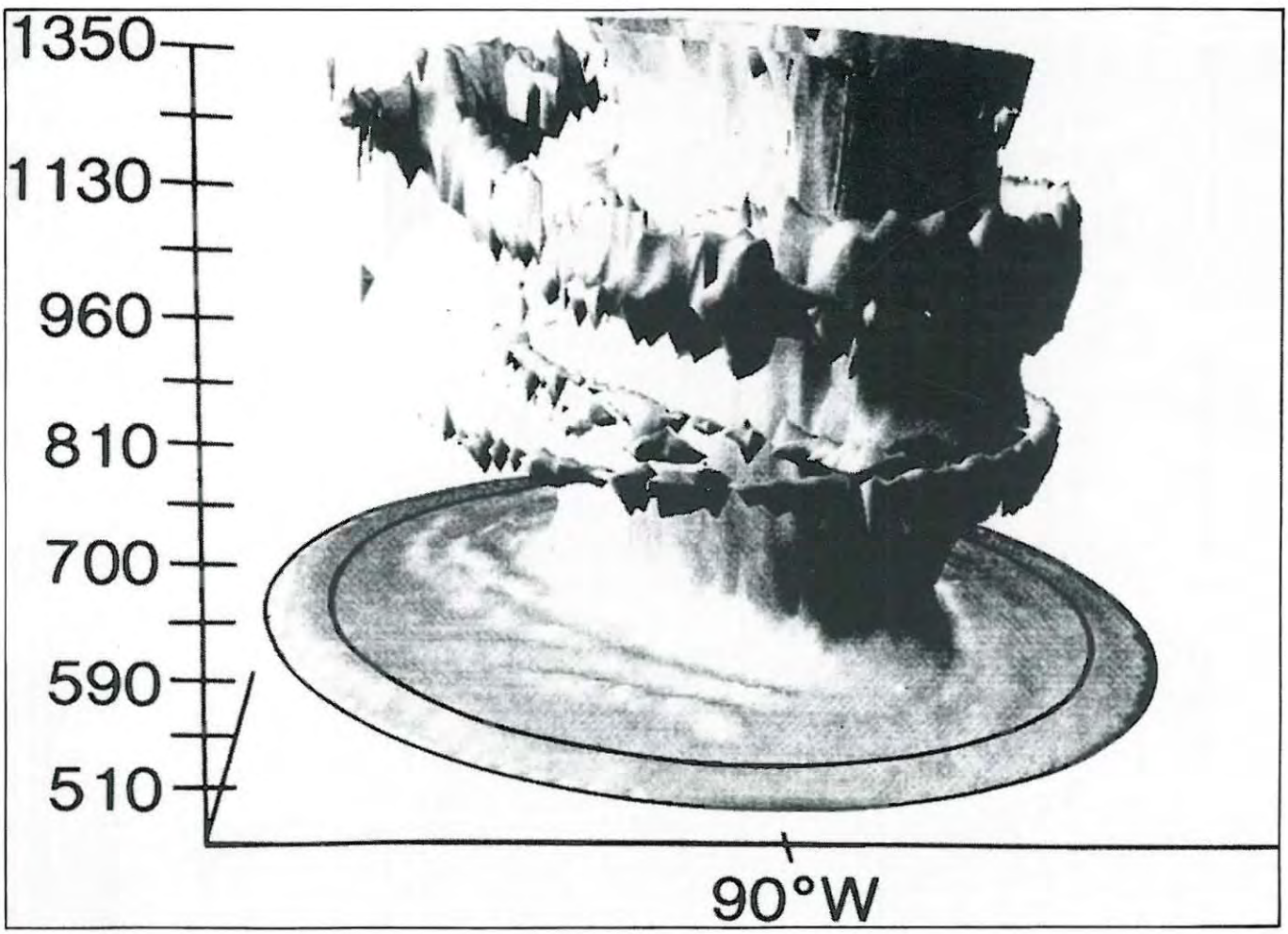
Stratospheric Polar Vortex



CMOS Bulletin SCMO

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Inside / En Bref

EDITOR'S COLUMN

The next issue of the ***BULLETIN*** **22**(5), October 1994, will go to press on September 20th, 1994. Contributions are welcome and should be sent before September 8 to:

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We do not have a person for typing nor translating so I need your contribution in a form that can be readily inserted into the Bulletin. The most convenient way is via E-mail to the above address.

I accept contributions submitted on floppy disk in standard DOS formats (i.e. WordPerfect (version 4.1 to 5.1), plain ASCII text files, MS Word - at the moment I use Word 6.0 for Windows), however, I can convert Macintosh files to DOS files.

If you want to send graphics, then HPGL files can be sent as ASCII files over the networks, any other format will have to be sent on paper or on a floppy disc. It is recommended that whatever software prepares an HPGL file be configured for the HP7550 printer. If you have the option of selecting pen colours, please don't. If you send a file over the network, send a copy to yourself and examine the transmitted copy to check that it is all there.

French does not transmit completely on internet. The problem is with accents that are maped above the standard ASCII set. It is still possible to send your text in French if you convert all accent characters into a specific code. This can be done by global change in your word processor. We only have to agree on a notation. I suggest the following codes:

é	/e/	è	\e\	ê	^e^	ë	:e:
ï	:i:	à	\a\	â	^a^	ö	:o:
ç	?c?	ù	\u\	É	/E/	È	\E\

When I find the time I will write a utility to convert this in both directions from plain text to ASCII Standard and vice versa.

Do you have an interesting photograph, say, an interesting meteorological or oceanographic phenomenon? If so, write a caption and send me a high contrast black and white version for publication in the CMOS Newsletter. Savonius Rotor is still alive for anyone who has an unusual point to make.

Jean-Pierre Blanchet,
CMOS Bulletin Editor

SECTION DE L'ÉDITEUR

Le prochain numéro du ***BULLETIN*** **22**(5), octobre 1994 sera mis sous presse le 20 septembre '94. Vos contributions sont les bienvenues. Me les faire parvenir d'ici le 8 septembre à l'adresse suivante:

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Nous ne disposons pas de personnel pour dactylographier ou traduire les textes soumis et je demande votre collaboration en m'envoyant vos textes sous forme électronique (poste internet ou disquette).

Les fichiers sur disquettes doivent être dans un format standard DOS (WordPerfect 4.1 ou 5.1, MS Word, texte ASCII). J'emploie actuellement MS Word 6.0 pour Windows. Je peux convertir les fichiers Macintosh équivalents vers DOS.

Les fichier graphiques peuvent être envoyés dans le format HPGL comme des fichiers normalisés ASCII ou sur papier de bonne qualité avec des caractères de dimension convenable pour une réduction à l'échelle de cette colonne.

Les textes en français peuvent être transmis par courrier électronique (internet) mais ceci nécessite une traduction des caractères ayant des accents. Je vous propose les codes montrés dans la colonne voisine, en utilisant votre éditeur pour faire le changement sur l'ensemble du texte avant la transmission.

Si vous avez de bonnes photographies pour notre page couverture, s'il vous plaît m'en faire parvenir une copie en noir et blanc bien contrastée avec une légende appropriée.

Jean-Pierre Blanchet,
éditeur du Bulletin de la SCMO

Note:

In one of the previous issue, we presented a picture of the First Annual Congress of CMOS (May 1967). About 8 persons in that picture were not identified. In de saga of identifying those individuals, I have received a couple of new names. The individual in position five is E.J. Llewellan, professor at the University of Saskatchewan. The person number 91 is Frank (Bud) Mahaffy, a meteorologist who retired in the late seventies.

Three-Dimensional Visualization of the Stratospheric Polar Vortex

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1. Introduction

A number of studies over the last decade have changed the standard view of the circulation of the extratropical winter stratosphere. McIntyre and Palmer (1984) examined the potential vorticity (PV) computed from analyzed fields based on satellite radiometer temperature measurements. They noted that the pole-to-equator gradient in PV tended to be concentrated in a narrow region around the edge of the polar vortex, which separated the high PV values inside the vortex from lower values in the subtropical "surf zone". In addition they found evidence for tongues of high PV air extending from the vortex into the *surf zone*. Leovy *et al.* (1985) found similar behaviour in satellite measurements of a quasi-conserved chemical tracer.

Acknowledging the limited spatial resolution of the satellite data, McIntyre and Palmer speculated that in the real world (or in a high resolution numerical model simulation) the gradients at the boundary of the vortex and along the edge of material entrained into the surf zone may be very sharp. These speculations were strikingly confirmed by very high resolution barotropic model calculations which showed the formation of strong gradients in PV, and the presence of thin filaments of high PV air within the low PV background of the surf zone (Juckes and McIntyre, 1987).

An important development was the demonstration that high-resolution 3D general circulation models (GCMs) can produce features in the stratospheric winter vortex similar to those seen in the idealized barotropic simulations. In particular Mahlman and Umscheid (1987) presented a horizontal section of the nitrous oxide (N_2O) mixing ratio from a simulation with the 1° resolution version of the GFDL SKYHI GCM.

More recently Strahan and Mahlman (1994a) have shown similar instantaneous sections of N_2O concentration for both the Northern and Southern Hemisphere winter stratosphere. These figures all display a sharp contrast between a relatively homogeneous N_2O mixing ratio within the vortex and much higher values outside, and filaments of low N_2O air can be seen extending into the surf zone.

One issue that has not been thoroughly investigated is the vertical structure of the filaments of vortex air that are entrained into the surf zone. This is an important aspect since much of the recent modelling work on the polar vortex dynamics has been conducted within the context of purely barotropic models. The recent study of Ward and Haynes (1993) emphasizes the importance of understanding the 3D structure of air mass motions in the stratosphere. They showed that the rate of dissipation of PV anomalies by the radiative diabatic heating depends on the vertical scale of the anomaly (in particular, shallow elements of PV can be expected to be dissipated rapidly). As a first step in an examination of this issue a technique for 3D visualization of polar vortex air in a model simulation is presented here.

2. The Model and the N_2O Simulation

The GFDL SKYHI model has been developed for comprehensive simulation of the atmosphere up to the mesopause. The version considered here solves the governing equations discretized on 40 levels in the vertical from the ground to 0.000,96 kPa (~80 km) and on a latitude-longitude grid with 1°x1.2° spacing. The details of the model formulation and performance can be found in Fels et al. (1980) and Hamilton et al. (1994). The version of the model used in the standard control experiments has included a prognostic equation for N_2O. Details of the implementation of the N_2O simulation and a discussion of the results can be found in Strahan and Mahlman (1994a,b).

N_2O has a slow chemical source and a very long chemical lifetime (>100 years) in the troposphere. In the middle atmosphere, however, N_2O is destroyed by photolysis and the chemical lifetime drops rapidly with height (~50 days at the tropical stratopause). The combination of this chemistry and the large-scale circulation results in a stratospheric N_2O distribution that is stratified in both the vertical and meridional directions.

The simulated zonal mean January climatology of N_2O mixing ratio in the SKYHI model is shown in Fig. 1. This large-scale stratification together with the fairly long chemical lifetime makes the N_2O mixing ratio a useful tracer of motions on timescales of days to weeks in the stratosphere.

Along any horizontal surface the lowest N_2O values are characteristic of vortex air. Air that leaves the vortex enters an environment with much higher N_2O concentrations. The strongest cyclonic flow is at the edge of the vortex, so air parcels stripped out of the vortex tend to wrap cyclonically around the outside of the vortex. As this occurs the parcels

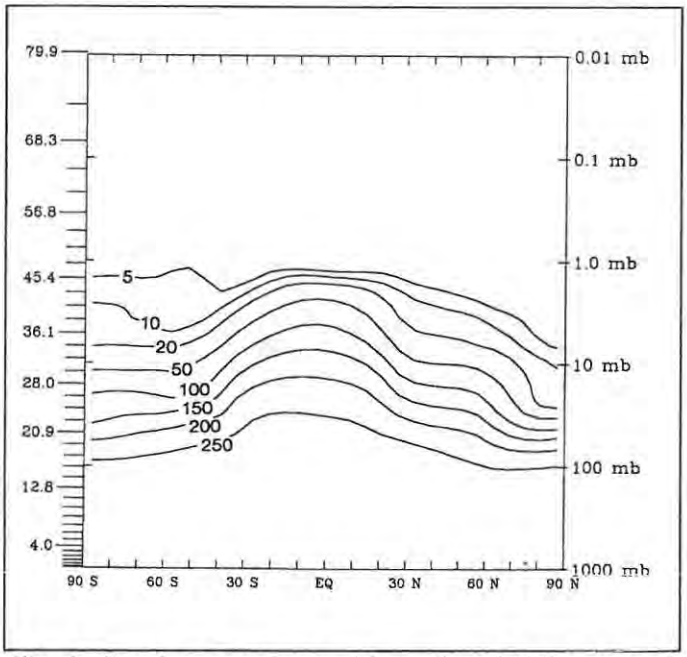

Fig. 1. *Zonal mean volume mixing ratios of N_2O averaged over a January in the 1° SKYHI control simulation. Contours labelled in parts per billion. The tick marks on the left are placed at the isobaric model levels and are labelled by their equivalent height (km) in a standard atmosphere.*

become progressively stretched out and diluted with the ambient high N_2O air.

Now this process is represented somewhat imperfectly by the SKYHI model. In particular, the transport of mixing ratio in the model is handled through an Eulerian scheme which is centered second order in the horizontal (although fourth order in the vertical). Thus the model will not exactly conserve mixing ratio along parcel trajectories, and this inaccuracy is likely to be most significant where parcels cross regions of intense Eulerian gradients (particularly when parcels move out of the vortex). In addition, the model includes subgrid-scale horizontal diffusion.

Despite these limitations, however, the SKYHI model can develop and maintain impressive horizontal gradients in tracer concentration, and the horizontal contrast in N_2O mixing ratio seen in the model simulations remains a useful indication of air motion. This indeed is the point first illustrated in the paper of Mahlman and Umscheid (1987).

3. Three-Dimensional Visualization

The analysis explored here starts with the interpolation of the simulated instantaneous N_2O mixing ratios, R, from the model isobaric levels onto surfaces of constant potential temperature, θ. Then on each surface a mixing ratio value characteristic of the inside of the vortex, $R_v(\theta)$, is defined by simply computing the average over the 1200 model gridpoints with the smallest values. Then a 3D field is defined as R/R_v. Isosurfaces of this ratio are then plotted with a visualization software package.

Fig. 2 shows the result over the Northern Hemisphere for a particular January day in the middle of the SKYHI control run. This particular figure is for a surface with ratio of 10. The interpolation was done onto 14 θ levels over a vertical domain that spans roughly the same number of SKYHI model levels. The isosurface appears as a vase-like sheath surrounding the vortex that deforms into a flat base sitting near the top of the (well-mixed) troposphere. The vortex in this case can be seen to be displaced somewhat from the pole and tilted with height. This reflects the presence of an Aleutian high which is centered in the lower left quadrant of the figure.

Of particular interest here are the parts of the isosurface that appear detached from the main vortex. In particular the isosurface surrounds several *filaments* of air at different heights that can be seen wrapped around the outside of the vortex. This is the familiar pattern seen in many earlier studies, and it is reasonable to regard the presence of these filaments as indicative of the erosion of air from the main vortex. Here, however, the reader can get a feeling for the vertical scale and coherence of the filaments.

From this single image the impression one gets is that in the lower stratosphere the eroded air tends to be confined to very shallow layers (essentially a single model level). In the upper stratosphere there seems to be more vertical coherence to the eroded material (at least over 2 or 3 model levels). There is no clear indication of extremely deep filaments (i.e. those that might be appropriately modelled with a purely barotropic system). The result in Fig. 2 is for a single time with a relatively undisturbed polar vortex, and obviously additional research will be necessary to determine how characteristic these features are.

The choice of plotting the isosurface for a concentration ratio equal to 10 is somewhat arbitrary. The main vortex sheath is not overly sensitive to changing this value, a fact that just reflects the sharpness of the concentration gradients at the vortex edge. The filaments do not appear clearly in plots of isosurfaces for values reduced much below 10. This suggests, not surprisingly, that eroded vortex air in the model comes preferentially from the vortex edge. It may also indicate that air coming from the vortex is very quickly diluted to a significant degree (presumably due largely to the inaccuracy of the Eulerian transport scheme). However, the impressively organized structure seen in Fig. 2 is a confirmation of the usefulness of the tracer distribution for determining the circulation in the model. A refinement of the present procedure is now being tried that scales the ratio R/R_v by a measure of the mean horizontal gradient at each θ.

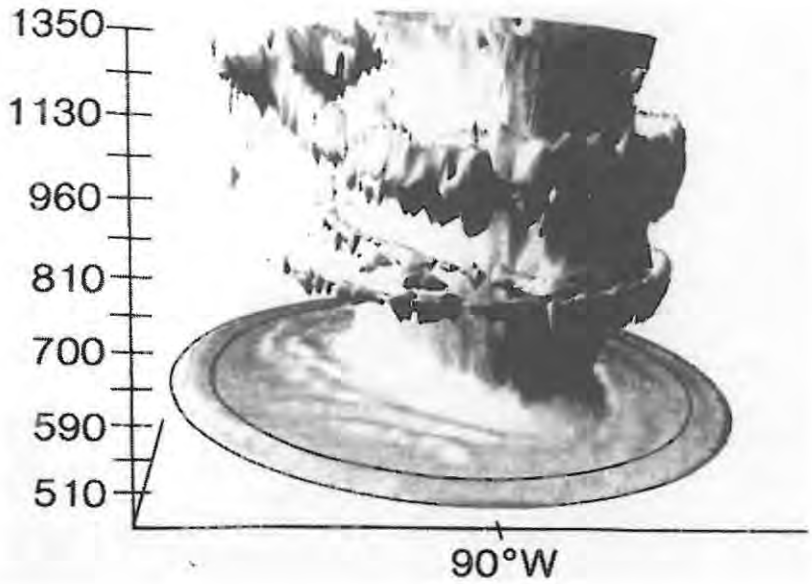

Fig. 2. Northern Hemisphere plot of the isosurface where the ratio of the N_2O mixing ratio at any potential temperature, θ, is 10 times that of the minimum value on the same θ-surface. The vertical scale is a function of θ and the axis is labelled in degree Kelvin. The whole hemisphere is displayed in a polar orthographic projection so the equator is at the visible edge at the bottom. The 30°N latitude circle is marked. The vertical domain extends from θ=450 K (upper troposphere) to θ=1350 K (about 0.3 kPa or 45 km).

4. Conclusion

The image presented here represents a simple attempt to visualize the 3D tracer structure in the stratosphere. The results are encouraging and similar visualization is now being attempted for the PV in the SKYHI simulated winter stratosphere. The method is also potentially useful in visualizing satellite measurements of tracer distributions, although it is unclear whether the spatial resolution of such observations would be suffcient to create useful pictures.

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The Canadian Branch during the 1950s

by
Morley Thomas

1. Background

The decade of the 1950s saw an uninterrupted expansion of meteorological activities in Canada. The population of the country increased from 14 to 18 million people and the federal government expenditures in the meteorological sector increased from $5.5 million in 1950 to $14.9 in 1959. In other words, the federal cost of meteorology per capita increased from 39 to 83 cents during the 1950s.

Natural weather events provided justification for expanding meteorological services during the decade. In 1950, the Red River floods in Manitoba during May and the forest fires in northern Alberta in September which cast a pall over the East, both drew the attention of Canadians to the atmospheric environment. The October 1954 flooding in Ontario caused by Hurricane Hazel, hot dry weather in Central Canada in the mid-1950s and several severe storms in Atlantic Canada towards the end of the decade continued to bring attention to weather, climate and meteorology.

To provide more and better service the Meteorological Division (Branch after 1956) expanded by establishing an Arctic Forecast Team in Edmonton in 1950 and a Central Analysis Office in Ottawa in 1952 (later moved to Montreal and renamed the Canadian Meteorological Centre). Research positions were created within the Branch which allowed participation in the research programs of the International Geophysical Year (1957-58), Alberta hail studies and weather modification experiments in Ontario and Quebec. Several meteorologists were seconded to other government agencies during the decade to work in applied meteorology in such sectors as agriculture, forestry, building research, hydrometeorology and atmospheric pollution. Assistance was given to McGill University to establish courses in meteorology and a grants in aid of meteorological research at universities program was begun. A punched card system was developed for handling climate data and a beginning was made in using computers in numerical weather prediction.

To fill posts in the expanding Meteorological Branch extensive recruiting programs were undertaken. Technicians were trained on the job at the regional offices at first but later at an Air Services Training School in Ottawa. An average of two dozen university graduates were recruited each year and given introductory and operational courses in meteorology at Toronto and at the Trenton RCAF station. In addition, a few mathematics and physics graduates were recruited and assigned to undertake graduate work in meteorology at the University of Toronto. There were resignations from the Branch, of course, but on the average the professional cadre in the Meteorological Branch grew by 25 or so each year.
Despite this period of expansion in Canadian meteorology,membership in the Canadian Branch did not grow appreciably. In 1950, the membership total was approaching 300 and, by 1959, there were only 330 members which amounted to an increase of barely 10% over the decade. Special meteorological events were happening that decade - the Toronto Meteorological Conference in 1953, meetings of the International Geophysical Union at Toronto in 1955, the staging of National Meteorological meetings and the Toronto Weather Festivals. But, most of these events were held in Toronto; at the time at least one meteorologist suggested the organization should be called the "RMS Toronto Branch." And there was a growing demand for a real Canadian meteorological publication, something better than the printing and distributing of copies of the papers and talks given at Toronto. Over the 1950 to 1958-59 period the presidents of the Canadian Branch were P.D. McTaggart-Cowan, F.W. Benum, D.P. McIntyre, R.C. Graham and W.L. Godson. This article tells of the activities of the Toronto-centered Branch over that period up to the move of the executive committee to Montreal in 1959.

2. Ordinary Meetings 1950-1954

Under the leadership of Patrick D. McTaggart-Cowan theCanadian Branch embarked on an ambitious program of meetings at Toronto and began to plan and hold meetings in other cities. In 1950, there were nine meetings at Toronto beginning with the January Presidential address entitled "The Jet Stream." Several of the speakers were visitors and included Dr. Heinz Reuter on post-war meteorology in Europe, Dr. Sverre Pettersen on the general circulation, Prof. C.H. Smiley on atmospheric refraction, R.F. Legget on building and climate and F/L K.R. Greenaway om Arctic flying weather. Dr. Reuter, from the University of Vienna, was in Canada on a UNESCO Fellowship and spoke at meetings of the Branch in Vancouver, Edmonton and Montreal and met with local meteorologists in Winnipeg.[1]

In 1951, there were three Meteorological Division paperspresented - McTaggart-Cowan's presidential address on post-war meteorology in Canada, Warren Godson's paper on synoptic properties of frontal surfaces and Ken Pettit's report on cloud physics at the National Research Council. In

[1] CMOS Archives, File 2-3. (NOTE: The sources of the basic information found in this and succeeding articles are the Annual Reports of the Executive committee and the minutes of the Executive committee meetings which are in the Archives. Hereafter these will not be footnoted. Other sources, such as correspondence and documents, will be footnoted.

addition, the Branch continued to recruit visitors to address the monthly meetings. While not always directly on meteorology, the talks were related to some applications of meteorology or to other activities where meteorology was a factor. The speakers included Dr. J. Namias on medium range weather forecasting, P.D. Baird on the Baffin Island Expedition, G.E. Dunn on the Chicago public weather office, Professor Griffith Taylor on the climates of Australia, Professor Tuzo Wilson on the origin of continents, A.F. Merewether on the use of facsimile in airline operations and Professors Donald Kerr and Kenneth Hare on climate change.

Much the same pattern was followed in 1952 under thepresidency of Frank Benum whose presidential address was on meteorology and aviation. The flying weather theme was continued by Messers Chamberlin and Rogers of A.V. Roe who spoke on jet aircraft, by Professor T.R. Loudon who spoke on the historical development of aviation in Canada and by A.St.G. Grant, a meteorologist seconded from the Division to the Department of Mines and Technical Surveys, who spoke on meteorology in electronic surveying. At another meeting, Rube Hornstein, Keith McLeod and Don McCormick were speakers at a symposium on "Weather in the Public Service." Meteorological science and theory were covered at other meetings by Don McIntyre speaking on instability in the atmosphere, Warren Godson on radiative fluxes and W.E.K. Middleton on the estimation and measurement of visual range.

Seven ordinary meetings of the Branch were held in Torontoduring 1953. Following the annual January business meeting, the president, Frank Benum, reviewed the history and current state of Branch affairs. Other speakers in the winter and spring were Hugh Cameron on the aerial environment of the forest, George Robertson on agro-meteorological problems, Morley Thomas on winter temperatures at Toronto and Harold Baynton on meteorology in the Windsor-Detroit air pollution studies. Another meeting featured the Canadian radiosonde. The speakers, Hugh Bindon, Wendell Smith and A.W. Hooper spoke on recent developments, adaption to rawinsondes and the pressure calibration chamber in use. In the autumn, visitors J.C. Dillon and O.J. McConkey spoke on forest protection in Ontario and world agriculture, respectively.

A copy of the 1954 annual report of the executive committeehas not survived in the archives but it appears the speakers to the Branch that year in Toronto were Dr. Donald McIntyre whose presidential address was on meteorological research and education in Canada, P.J. Sandiford speaking on meteorology in Ontario Hydro, Ted Munn speaking on graphical methods he had developed for aviation forecasting at Torbay airport in Newfoundland and Percy Saltzman whose subject was weather on television. The featured meeting of the year was a public lecture, then known as the First Toronto Weather Festival, given by Rueben Hornstein, officer-in-charge of the Halifax Forecast Office. The subject was "Hurricanes," and the speaker and his subject drew a good attendance at the Royal Ontario Museum Theatre on December 2, 1954. The lecture was covered by the Toronto newspapers and there was a large demand for copies when the paper was published in the Canadian Branch Publications series.

3. Ordinary Meetings 1955-1959

Eight ordinary meetings of the Branch were held in Torontoin 1955. In January, a panel of five people discussed aviation weather problems and, the next month, Don McIntyre spoke on his forecasts for meteorology in 2000 AD. Other meteorologists who spoke were Dick Douglas on snow-generating cells and Les MacHattie on the ramifications of relative humidity in forestry. Visiting speakers that year were George Jacobsen speaking on the Arctic, B.C. Newbury on meteorology and air pollution and Helmut Landsberg (United States) who spoke on climatology. The program year ended in November with the Second Toronto Weather Festival at the Royal Ontario Museum Theatre where several members of the Malton Weather Office staff answered the question "Who is the Weatherman?" Later, in answer to some criticism that the Branch was doing too much in Toronto, at the expense of other parts of the country, the secretary wrote explaining that the two Weather Festivals held in 1954 and 1955 were arrranged "solely by Toronto meteorologists and paid for solely by them as an experiment in public education."[2]

There was no Weather Festival in 1956 since attention thatfall was given to holding the Second National Meeting of the Branch in Toronto during the annual officers-in-charge conference of the Meteorological Branch. Four papers were presented at that meeting. In addition, there were eight ordinary meetings involving both visitors and members as speakers. One visitor was E.B. Kraus (Australia), who spoke on technical and theoretical aspects of climatic fluctuations. In April, a panel discussion on meteorology and gliding was held with meteorologists and soaring enthusiasts participating. Members who spoke at other meetings included President Bob Graham whose subject was international meteorology; Warren Godson on the interplay of gravity and diffusion in atmospheric pollution; Roy Lee on the arctic stratospheric jet stream during the winter of 1955-56; Hugh Bindon on the measurement of humidity; and, finally, Bob Graham, Keith McLeod and J.E. Michie on "Wind, weather and white-caps -the problems of small craft." When published, this last paper became a best seller.

The calendar year 1957 saw only three ordinary meetings ofthe Canadian Branch but, in addition, the Branch hosted two National Meetings and two symposia in Toronto. Speakers at the ordinary meetings were President Graham whose topic was upper winds for aviation; Professor Stewart Marshall of McGill University who spoke on recent developments in cloud physics; and Professor Ken King of the University of Guelph who spoke on the effects of soil, plant

[2] CMOS Archives, File 3-2, Lee to Washburn, November 21, 1956

and meteorological factors on evapotranspiration. The first symposium, held in February 1957, dealt with high-speed data processing applied to meteorology with speakers Hugh Bindon, Bev Cudbird and Gib Henry. The second symposium, in April, dealt with the International Geophysical Year with talks on astronomy, glaciology and meteorology by Professors MacRae and Jacobs of the University of Toronto and Warren Godson, respectively. The Third National Meeting, in June, dealt with hydrometeorology and featured three speakers. The Fourth National Meeting occured in November with seven speakers on weather analysis and forecasting.

In 1958, eight ordinary meetings of the Branch were held inToronto. The winter and spring meetings were on strictly meteorological subjects - Warren Godson on meteorological applications of satellites, Hugh Bindon on the standardization of barometers, Professor Ken Hare on the Arctic stratosphere and Dick Douglas on Alberta hail studies. In May, a Ladies Night featured colour film presentations. In the fall, Andrew Thomson and Warren Godson spoke of their recent visit to meteorological institutes and facilities in the USSR. The Fifth National Meeting took place in November with three speakers and, later that month, another Ladies Night was held during which Andrew Thomson and Warren Godson presented their colour films of southeast Asia and the USSR.

The late winter and spring of 1959 passed without anyordinary meetings of the Canadian Branch in Toronto except the presidential address on May 14 by Warren Godson who spoke on some unusual aspects of the Arctic winter troposphere. This was also the date of the final annual business meeting of the Branch in Toronto before the executive committee moved to Montreal.

4. Canadian Branch Publications

In 1950, the Branch began publishing the papers presented atthe Toronto meetings. Many members had complained that there was little about North American weather in the RMS publications -Weather and the Quarterly Journal. Others complained that members who lived and worked outside Toronto received little for their annual fees. By deciding to publish the Canadian papers the Executive committee met both complaints and probably kept many members from resigning. There were some questions from the parent Society since it was feared the new publication would cut into the regular RMS publications area but these fears were soon allayed.

More than 800 copies of volume I, number 1 of the RoyalMeteorological Society Canadian Branch Publications - President McTaggart-Cowan's "The Jet Stream" - were printed and distributed. There was much interest in the jet stream, still a relatively new meteorological topic at that time, and no other Canadian Branch Publication would ever be in such demand. Eight more issues of volume I appeared in 1950. When the last issue appeared in 1959 (volume IX, no. 1), 50 numbers containing more than 60 papers had been published. Much credit must be given to the Meteorological Division for complete support in this first Society publishing effort. Editing was done in the office on "company time," the printing was done in-house by the Division and mailing was done by teams of "volunteers" at Meteorological Headquarters, again on company time. However, the postage was paid by the Canadian Branch. A price of 25 cents was placed on individual issues although the secretary was given authority to give away copies when this would be in the interest of the Branch. Volume 1 (1950) was edited by the secretary, Frank Benum, volumes 2 to 5 by Percy Saltzman, volume 6 by Reid Allen and volumes 7 to 9 by Morley Thomas.

Much consideration was given to selecting a title for theirregularly issued Publications. In 1952, such titles as Proceedings, Journal, Bulletin and Annals were suggested and the membership was canvassed for opinions and more suggestions. But, few if any new suggestions were made and so no action was taken to give Publications a more suitable title. Librarians complained that the publication was a periodical with no fixed dates for publication and the secretary had to handle many enquiries about suspected missing copies. The Canadian Branch Publications series ended when the Executive committee moved from Toronto to Montreal. Publications served a need of the times by disseminating Canadian meteorological papers which otherwise might never have been printed and it did allow several authors to appear in print for the first time.

Discussions pertaining to the lack of an accredited journalhad been underway before the move of the Executive committee to Montreal. In August 1958, James Bruce wrote to the Branch secretary outlining his suggestions for a proper journal and he included a table of contents based on meteorological papers and articles published by Canadians over a three month period in early 1958. He had also investigated the costs of comparable quarterly journals and concluded that "the first step in achieving the goal of a worth-while Canadian journal of meteorology is to form a Canadian Meteorological Society."[3] His conclusion proved to be correct and both independence and the journal were to come within a decade although in reverse order.

Within a few months of forming the Executive committee in1959 the Montreal meteorologists decided not to continue the Canadian Branch Publications series although it would be 1963 before the first issue of the Canadian Branch's new publication, Atmosphere, appeared.

[3] CMOS Archives, File 3-5, Bruce to secretary, August 1, 1958.

5. RMS Centenary Celebrations

During the spring of 1950 the Royal Meteorological Societyheld Centenary Celebrations in England to mark the 100th anniversary of the Society. A four-day scientific meeting was took place at Oxford at which Dr. W.L. Godson was the Canadian Branch's representative. He contributed a paper on "The structure of North American weather systems" at one of the sessions. This paper, along with others presented, was published in the Centenary Proceedings of the Royal Meteorological Society 1950. Further, the Branch was given the opportunity to mount an exhibit at the Science Museum in London. The theme was "The science of weather" and covered the history of meteorology - observing, forecasting, applications and research. The Canadian exhibit consisted of Canadian meteorological observing instruments used in the Arctic. An anemometer, a Patterson-Kew barometer, a mercury-thallium thermometer, a rain gauge and an actinograph were provided for the exhibit.[4]

6. An Independent Meteorological Society of Canada?

While always acknowledging that the Branch was a body of theRoyal Meteorological Society, the post-war Executive committees exhibited definite independent characteristics from time to time. This was encouraged by complaints from the parent Society regarding inadequate fees from Associates and from the Canadian members regarding delays in processing applications and the non-receipt of publications. These matters were eventually settled, as related in the following paragraphs, but it must be noted that the possibility of an independent society was actively considered several times.

In October 1950, Sir Robert Watson-Watt, of radardevelopment fame and president of the RMS that year, met with members of the Branch Executive in Toronto to discuss mutual problems. The continuing, most significant problem of that era was the amount of money the Canadian members were asked to pay annually. There are no minutes from the meeting but, within a few days, President McTaggart-Cowan wrote to Sir Robert outlining the Canadian views, proposing that the Canadian Branch assume responsibilty for all fees from Canadians and suggesting a formula, based on costs, for setting Associates fees.[5] He asked that the matter be discussed at the next RMS Council meeting and, in the meantime, the Branch took responsibility for all Canadian fees and for collecting from the members in Canada.

By June 1951, when no response had been received fromLondon, the Canadian Branch Executive committee, led by new president Frank Benum, were prepared to threaten separation. That month, Professor P.A. Sheppard, then editor of the Quarterly Journal, happened to be in Toronto and met with the committee for a thorough discussion of the relationship of the Canadian Branch to the parent Society. Benum suggested that the Branch should ultimately become independent, have two classes of membership -professional and ordinary, and that members would receive all RMS publications which the new Meteorological Society of Canada would purchase in bulk. However, discussion revealed that many Canadians liked the prestige of being an RMS Fellow and they were not anxious to pay the increased fees necessary to maintain an independent society. It was agreed that the matter should be brought up at the next annual meeting of the Branch and Sheppard volunteered that the RMS would give sympathetic hearing to any proposal which would assist the Branch in "achieving the degree of independence which it considered desirable."[6]

7. Membership Fees

For a number of years after the war economic conditions werepoor in Britain and such organizations as the Royal Meteorological Society suffered. At the suggestion of a Canadian member, in 1950, a small supply of tea and sugar was sent by the Branch to England to allow tea to be served at the RMS meetings. There was also an appeal to individual members for funds to assist the Society in rehabilitating the Society's properties.

It is no wonder, then, that the parent RMS found itnecessary to complain when it was shown that the Canadian Associate members did not bear an equable share of the total expenses of the Society, especially the printing and distributing costs of Weather. The Canadian Associate fees were $6 and Fellows fees were $8. On the other hand, several Canadian members received dunning letters from London in the summer of 1950 alleging that their fees had not been paid for that year when they had. The Branch collected fees from Canadians, retained 25% for Branch activities and forwarded the rest although the Society maintained an account for each member in London. When there was a delay in sending information to London considerable confusion could and did arise.

So, as mentioned in a paragraph above, the Branch proposedto London that it become responsible for the entire payment of fees due the Society and that only one account be maintained for Canadian members. The fees for Associates and Fellows in Canada would be set by the Canadian Branch and would be composed of the fee required by London plus

[4] CMOS Archives, File 1-5, Ashford to Godson, September 1949 and Chilton to Benum, November 29, 1949.

[5] CMOS Archives, File 2-1, McTaggart-Cowan to Watson-Watt, October 17, 1950.

[6] CMOS Archives, File 2-3, Minutes of meeting of Executive committee, June 12, 1951.

the Canadian Branch administrative assessment. This proposal was accepted in 1951; the Branch paid fees for 31 delinquent members and still showed a profit on the year of over $200. There was a counter proposal from London in April 1952 proposing that while the Associates fees would remain at two pounds, the Branch share would decrease from 25% to 15%. This was accepted along with the introduction of an entrance fee for Associates and an increase in Fellow's fees to three pounds, three shillings with the Branch retaining 15% rather than 25%. Accordingly. in dollars, the 1952 fees became $6.75 for Associates and $8.65 for Fellows with an entrance fee of $2.45 for all new members.

For a few years no changes were made in the fees schedule.Members who were delinquent in paying their fees continued to be a problem since the Branch had assumed responsibilty. All delinquent members were covered for one year but then they were suspended and their names were removed from the publication distribution lists. In December 1952, with an apparent membership of 350, 15 of these members had been suspended for not paying 1951 fees. A year later, the membership totaled 357 which included 19 members suspended for not paying 1952 fees. In fairness it must be stated that most suspended members were people who had left employment in meteorology or who had careers in sectors where meteorology was not too important. Most suspended meteorologists eventually paid their fees.

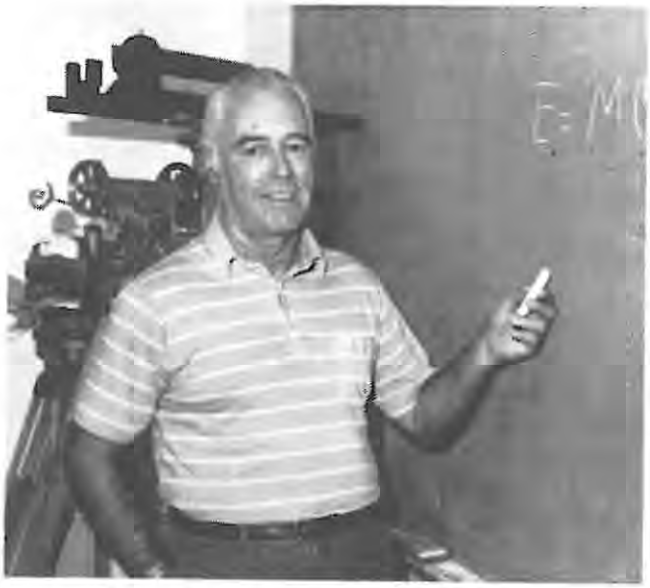
In 1957, the parent Society advised that it had lost inexcess of four shillings on every Associate member and that fees for all classes of membership were to be raised. So, after a constant level of fees since 1947, the Canadian Branch raised Fellow's fees for 1958 to $11.50, Associates to $9.00 and the entrance fee to $2.50. The Branch continued to be responsible for all Canadian fees and now forwarded 90% of the Associates fees and 85% of the other fees to London. There was no change in 1959 and in January 1960, the parent Society abolished the Associate class of membership and all Canadian members became Fellows.

8. Financial Affairs

From the beginning, the Canadian Branch treasurer hadcollected the fees of members and forwarded three quarters of the total to the parent Society along with the names of those who had paid. By the end of 1948, although the Branch reported a loss of $25 on that year, a surplus of $530 had been accumulated of which $300 was invested in bonds. Despite assuming responsibility to London for all Canadian fees, beginning in 1950, the Branch was able to show a surplus most years.

In 1951, the treasurer handled receipts and expendituresamounting to slightly more than $2,300 annually, mostly in fees since the sale of publications rarely brought in more than $100 a year. By the end of the decade, the receipts and expenditures exceeded $3,300 and the Branch had accumulated a surplus of more than $2,000.

(This chronicle is to be continued in the next issue)



André Robert (1929-1993)

by

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(A French version of this text has appeared in the journal "Le Climat", vol. 12 no. 1, 1994, 81-94. The English translation has been performed by Mr Richard Harvey)

Professor André Robert passed away on November 18th, 1993, at age 64, struck by a heart attack during his sleep. André Robert has dominated his field of research more than any other Canadian meteorologist, and equally so on the national and international fronts. As it is the norm in highly specialised research fields, most of the celebrity in the wake of great scientists remains confined within the circle of scientists working in the same area. I want here to pay tribute to André's career, showing his contributions to the advancement of knowledge and the immense loss his death represents for the scientific world.

1. THE SOLITARY SCIENTIST

Throughout his scientific career, André Robert worked with unsurpassed dedication to design new numerical methods to improve mathematical models used for numerical weather prediction and climate simulation. Probably few are aware that André had been the first Canadian Scientist to successfully perform a general circulation simulation (Robert, 1966), before the establishment of a climate research group, distinct from the numerical weather prediction one, and well before the general enthusiasm for the global change problem. This simulation served as validation for the spectral method that he was already proposing for numerical weather prediction models. He performed a 220-day integration using a 5-layer, low-resolution model (in fact, the horizontal resolution was 12 times smaller than today's climate models!), in which he specified a thermal forcing function to emulate the radiation absent from his simplified model.

An outstanding mathematician, André's approach to numerical modelling was essentially pragmatic. Contrary to many scientists in this field who aim at improving the accuracy of their schemes, he always professed to devise "efficient" numerical methods, that is to say, to attain a given degree of precision with the least amount of computation. The numerical schemes that he developed are now used in models of the world's largest weather prediction and climate research centres. Annex 1 presents a version of his Curriculum Vitae that I believe was written in late 1985; this autobiography reflects with eloquence André's career and some of his personality traits. In the following paragraphs, I will present his most important contributions during the past few years.

André came back to research in 1980, after a 7-year term as the head of the Canadian Meteorological Centre. Since then, his effort mainly focused toward the development of the semi-Lagrangian (SL) transport scheme. This logically followed his career path in which he always tried to design numerical methods that offered good precision-to-computing cost ratios. The semi-implicit method that he had introduced in meteorology a decade earlier is a good example of his pragmatic approach. His preference for SL method over the more traditional Eulerian method reflected his view that temporal truncation errors are much smaller than spatial ones in Eulerian schemes. Therefore, in principle, the timestep used in models could be lengthened considerably without compromising on their overall accuracy. Due to its great numerical stability, the SL scheme offers such an increase of the timestep by a factor of at least 3, thereby reducing computing times by nearly the same amount.

In 1987, André retired from the Canadian Atmospheric Environment Service where he had spent most of his professional career, to join the Atmospheric Sciences group at UQAM's Physics Department. He obtained the status of Professor Emeritus from the Canadian Government. In the fall of 1988, he and I, in collaboration with Monique Tanguay, devised an extension of the semi-implicit semi-Lagrangian method to apply to the non-hydrostatic fully elastic Euler equations (Tanguay *et al.* 1990). This gave birth to the so-called UQAM model, later renamed MC2 (Mesoscale Compressible Community) model by the CCRM (Cooperative Centre for Research in Mesometeorology). This generalisation of his limited-area model allowed him to tackle fluid mechanics problems that go well beyond meteorological applications, such as turbulent flow around small objects using sub-millimetre grids, flow in a cavity, and supersonic flow.

Far from slowing his activities, he in fact had increased the pace of his research these past few years, during which he continued to spread a contagious enthousiasm for his scientific work. Shortly before his death, he had obtained full Professor status at UQAM and had been granted a sabbatical leave to go to CERCA (Centre de recherches en calcul appliqué) next year. At the time of his death, he was supervising four Master's Degree students who were working on simulations of various fluid mechanics phenomena, such as the rotating annulus, supersonic flow around solid objects, cavity flow, and the oceanic circulation. He was also co-directing a Ph.D. student who is developing a large-scale oceanic circulation model. He leaves behind him numerous unpublished notes on his current research projects.

In an era in which team work is clearly privileged by granting agencies such as Québec's FCAR, André held a radically different view that, by some, could have been qualified as anachronous. According to him, one's best work is accomplished individually, whereas collaborative work is inefficient and ultimately results in wasted time and energy. Maybe he was not entirely wrong! To my knowledge, all his relations with other people had been "one-way" during his collaborative endeavours, with he as the absolute lead.

In spite of his shyness, he was a great communicator and his presentations were highlighted by an enthusiasm for his work that systematically flowed to the audience. A simple and modest person, particularly with little-educated people, he was nonetheless able to talk with an authority only surpassed by his objectivity about his scientific accomplishments and their impacts on the advancement of numerical modelling. He never fled controversy, from which he seemed to derive great stimulation, nor did he ever seek research projects to fit the main stream. Even if, in retrospect, all will concur with the international scope and importance of his work, it has to be recognised that his findings usually did not initially meet unanimous agreement. In fact, it would take typically several years after publication of an idea to reach a certain consensus on the relevance of his choices in the meteorological modelling community. This proved to be the case for the spectral method, the semi-implicit scheme, and more recently the semi-Lagrangian scheme. He once said to me that he considered research scientists as being overly conservative in their approach to science; while this remark surprised me at first, I was later able to verify it.

Gifted by a great intelligence, André was also a workhorse. It is his dedication and motivation at work that propelled him to the highest summits of his research field. In addition to his direct contributions to science, he trained many future scientists through directing research projects of many graduate students and colleagues during his career, as well as through teaching at UQAM over the past few years. The homages I received at his death (Annex 2) are an eloquent and unanimous proof of the emptiness left in his wake.

2. RECENT PUBLICATIONS

Rivest, C., A. Staniforth and A. Robert, 1994: Spurious resonant response of semi-Lagrangian discretizations to orographic forcing: diagnosis and solution. Mon. Wea. Rev., approved for publication.

Robert, A., 1993: Incompressible homogeneous fluids. Research notes. 27 p. incl. fig.

Robert, A., 1993: Le schéma semi-lagrangien. Research note. 6 p.

Robert, A., 1993: Application of a semi-Lagrangian model formulation to non-stationary supersonic flow. Research note. 9 p. incl. fig.

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Tanguay, M., E. Yakimiv, H. Ritchie and A. Robert, 1992: Advantages of spatial averaging in semi-implicit semi-Lagrangian schemes, Mon. Wea. Rev. **120**(1), 115-123.

Jakimow, G., E. Yakimiw and A. Robert, 1992: An implicit formulation for horizontal diffusion in gridpoint models. Mon. Wea. Rev. **120**(1), 124-130.

Tanguay, M., A. Robert and R. Laprise, 1990: A semi-implicit semi-Lagrangian fully compressible regional forecast model. Mon. Wea. Rev. **118**(10), 1970-1980.

Yakimiw, E. and A. Robert, 1990: Validation experiments for a nested grid-point regional forecast model. Atmos.-Ocean **28**(4), 466-472.

Tanguay, M. and A. Robert, 1990: An efficient Optimum interpolation analysis. Atmos.-Ocean **28**(3), 365-377.

Desharnais, F. and A. Robert, 1990: Errors near the poles generated by a semi-Lagrangian integration scheme in a global spectral model. Atmos.-Ocean **28**(2), 162-176.

Bergeron, G., J. Côté and A. Robert, 1990: Resolution sensitivity experiments with a spectral model of the shallow water equations. Research note. 14 p. plus fig. and tables.

Robert, A. and E. Yakimiw, 1986: Identification and elimination of an inflow boundary computational solution in limited area model integrations. Atmos.-Ocean **24**(4), 369-385.

Tanguay, M. and A. Robert, 1986: Elimination of the Helmholtz equation associated with the semi-implicit scheme in a grid point model of the shallow water equations. Mon. Wea. Rev. **114**(11), 2154-2162.

Yakimiv, E. and A. Robert, 1986: Accuracy and stability analysis of a fully implicit scheme for the shallow-water equations, Mon. Wea. Rev. **114**(1), 240-244.

ANNEX 1: AUTOBIOGRAPHICAL CURRICULUM VITAE (translated from the original in French, circa 1985)

Born on April 28th, 1929 in New York City (United States) from Mathias Robert and Irene Grindler. Emigrated to Canada in Grand-Mère (Québec) in May 1937. Obtained Canadian Citizenship in 1967. Received elementary and high-

school education at Sacré-Coeur Academy in Grand-Mère. University education completed at Laval University in 1952 with a Bachelor of Science Degree (Mathematics). Master's Degree in Meteorology obtained in 1953 from the University of Toronto. Married to Marguerite Mercier in 1953; had two daughters, Claire (1954) and Lise (1958).

Hired by the Atmospheric Environment Service in 1952, worked as forecaster in Dorval (Québec) at the international aviation and public forecasts desks for the Québec Region. Transferred in 1959 to the Numerical Weather Prediction Research Branch and appointed to the development of atmospheric models for short and medium-range forecasts. Ph.D. in Meteorology obtained in 1965 at McGill University. For one year, Professor at the Department of Meteorology of McGill University (1970-71). Promoted as Chief of the Numerical Weather Prediction Research Branch (21 employees) in 1971. Promoted as Director of the Canadian Meteorological Centre (143 employees) in 1973. Promoted as Senior Research Scientist in 1980.

Main accomplishments

The semi-implicit scheme

It is an entirely new numerical method, designed and tested for the first time in 1967. This techniques allows for the lengthening of the timestep by a factor 6 without compromising on the overall accuracy of the forecasts. On the supercomputers used in meteorology, this also results in a 6-time reduction of computing costs. The first tests were done with a spectral model, and it was later shown that the technique works also very well with grid-point and finite-element models. Canada adopted this strategy in 1974, followed by Australia in 1976, the European Centre in 1977, and the United States in 1980. This method is used today by more than half of the world's meteorological Centres, including the USSR (now the Community of Independent States) and China.

The spectral method

Succeeded in performing the first integration with a spectral model using the full meteorological primitive equations. He was the only one in the world between 1963 and 1970 to attempt to produce meteorological forecasts with a spectral model. The main difficulty was in the prohibitive computing time required by the model on the computers of the day. This problem was solved with the advent of the semi-implicit scheme and especially by the transform method introduced by a Dane (Bennert Machenhauer) in 1970. Canada was the first in 1976 to use a spectral model to produce meteorological forecasts, followed by the United States in 1980 and the European Centre in 1983. This method is gradually expanding to reach other meteorological Centres around the world.

The semi-Lagrangian scheme

This technique was designed and tested for the first time in 1980. It involves combining the pre-existing Lagrangian methods to the semi-implicit scheme, accounting for a further increase in the timestep by a factor six. It is used in Ireland to produce forecasts since 1982 and in Canada and Australia since 1988. It is believed that the method will be eventually adopted by many other meteorological Centres.

Operations automation at CMC

This program was enforced during the 1973-1980 period and contributed in eliminating 45 jobs (out of 140). It also contributed in a 40% increase in productivity of the Canadian Meteorological Centre (CMC) as well as a sizeable increase in the quality of its products. Thanks to this program and other similar initiatives, CMC now ranks fourth in the world after the European Centre, the National Weather Service in Washington and the U.K. Meteorological Centre.

The time filter

It is a minor contribution proposed in 1967 and used in almost every atmospheric models.

The first Canadian operational models

Design, development and implementation in 1963 of the first (barotropic) Canadian model. Design, development and implementation in 1968 of the second Canadian model (baroclinic model).

Awards and recognition

Second Half Century Award from the American Meteorological Society awarded in 1981. Patterson Medal awarded in 1986 from the Atmospheric Environment Service. The President's Prize of the Canadian Meteorological and Oceanographic Society awarded in 1967 and again in 1971. Elected Member of the Royal Society of Canada in 1982. Named Fellow of the American Meteorological Society in 1968. Was president of the Working Group in Numerical Experimentation at the World Meteorological Organization (WMO) from 1971 to 1973. Member of that Group from 1970 to 1976. Editor from 1972 to 1976 of "Research Activities in Atmospheric and Oceanic Modelling", published by the WMO.

Invited in 1968 by the North Atlantic Treaty Organization (NATO) to give conferences in Europe, particularly in France, Germany and Belgium. Presided over three international conferences:

1- WMO Study Group Conference on the Parameterization of Subgrid-Scale Physical Processes. Leningrad, March 1972.

2- WMO Study Group Conference on Modelling Aspects of GATE. Tallahassee, Florida, January 1973.

3- International Symposium on Spectral Methods in Numerical Weather Prediction. Copenhagen, August 1974.

Member of the Canadian Delegation at the 7th WMO Congress in 1975. Member of the Meteorology and Atmospheric Sciences Sub-Committee of the National Research Council from 1968 to 1972. Member of the grants committee in Meteorology, Aeronomy and Astronomy of the Natural Sciences and Engineering Research Council from 1980 to 1983. In the past 10 years (1975-1985), was thesis director for five Master's Degree and three Ph.D. candidates at McGill University.

Upon an invitation from the National Weather Service, completed five 45-day training courses in Washington in 1968 and 1969. From 1968 to 1972, many people came to the Numerical Weather Prediction Research Branch to work on the spectral method:

F. Schmidt, from West Germany, for five months
M.K. Mak, from Taiwan, for one year
G.T. Gordon, from the U.S., for two months
W.S. Bourke, from Australia, for one year
I. Simmonds, from Australia, for two years
H. Sundquist, from Sweden, for one year and
K. Puri, from Australia, for one year.

Scientific publications (textbooks, journals, etc.) now talk of the spectral method and the semi-implicit scheme as one of the most important developments that took place in the numerical weather prediction field (see the foreword written as Appendix by Prof. Smagorinsky in September of 1979). The following is an excerpt of that foreword:

> "The spectral method, for instance, which 10 years ago was regarded as impractical for weather forecasting, has been developed to become a very realistic alternative for numerical representation and has in fact already at some places replaced grid-point models in operational numerical weather prediction" (J. Smagorinsky).

> "The semi-implicit method has made it possible to use much larger timesteps, and as a result an integration with the primitive equations can now be advanced as fast as any integration with the quasi-geostrophic equations" (J. Smagorinsky).

List of publications (till 1985)

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Robert, A., 1983: The design of efficient time integration schemes for the primitive equations. Proceedings of the Seminar on Numerical Methods for Weather Prediction. European Centre for Medium-Range Weather Forecasts. 2, 193-200.

Robert, A., T. L. Yee and H. Ritchie, 1983: Application of the semi-implicit and semi-Lagrangian integration scheme to a limited area model. Proceedings of the Seminar on Numerical Methods for Weather Prediction. European Centre for Medium-Range Weather Forecasts. 2, 201-212.

Robert, A., 1982: A semi-implicit and semi-Lagrangian numerical integration scheme for the primitive meteorological equations. J. Meteor. Soc. Japan, 60, 319-325.

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Robert, A., 1979: The Semi-implicit method. Numerical Methods used in Atmospheric Models. WMO, GARP Publication Series No. 17, Chap. 8, 419-437.

Robert, A., 1975: Sensitivity experiments for the development of NWP models. Proceedings of the eleventh Stanstead Seminar. Department of Meteorology, McGill University, 68-81.

Robert, A., 1974: GARP activities related to computational considerations. WMO Working Group on Numerical Experimentation, Rep. No. 4, 2-23.

Robert, A., 1973: Computational resolution requirements for accurate medium-range numerical predictions. Symposium on difference and spectral methods for atmosphere and ocean dynamics problems. Siberian Branch of the Academy of Sciences, Novosibirsk, U.S.S.R., 82-102.

Robert, A., J. Henderson and C. Turnbull, 1972: An implicit time integration scheme for baroclinic models of the atmosphere. Month. Wea. Rev., 100, No. 5, 329-335.

Robert, A., 1971: Truncation errors in a filtered barotropic model. Proceedings of the Ninth Stanstead Seminar. Department of Meteorology, McGill University, 13-28.

Kwizak, M. and A. Robert, 1971: A semi-implicit scheme for grid point atmospheric models of the primitive equations. Month. Wea. Rev., 99, No. 1, 32-36.

Robert, A., F.G. Shuman and J.P. Gerrity, 1970: On partial difference equations in mathematical physics. Month. Wea. Rev., 98, No. 1, 1-6.

Robert, A., 1969: An unstable solution to the problem of advection by the finite-difference Eulerian method. Office Note No. 30, National Meteorological Center, Washington, D.C.

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Robert, A., 1968: The treatment of moisture and precipitation in atmospheric models integrated by the spectral method. J. of Appl. Meteor.. 7, 730-735.

Robert, A., 1968: The integration of a spectral model of the atmosphere by the implicit method. Proceedings of the International Symposium on Numerical Weather Prediction. Tokyo. 19-25.

Robert, A., 1968: Integration of a spectral barotropic model from global 500-mb charts. Month. Wea. Rev., 96, 83-85.

Robert, A., 1967: The incorporation of precipitation into a spectral model of the atmosphere. Proceedings of the Seminar on the middle-atmosphere. Stanstead, Québec. Department of Meteorology, McGill University, 91-114.

Robert, A., 1966: The integration of a low order spectral form of the primitive meteorological equations. J. of the Meteo. Soc. of Japan. 44, 237-245.

Robert, A., 1965: The integration of the spectral form of the primitive equations. Proceedings of the Symposium on the dynamics of large-scale atmospheric processes. Academy of Sciences of the U.S.S.R., Moscow, 66-69.

Robert, A., 1965: The behaviour of planetary waves in an atmospheric model based on spherical harmonics. McGill University. Publication in Meteorology No. 77.

Robert, A., 1963: A baroclinic model for the Canadian numerical weather prediction program. Seminars on the Stratosphere and Mesosphere and Polar Meteorology. Stanstead, Québec. Department of Meteorology, McGill University, 83-88.

Robert, A., 1963: Baroclinic experiments with a four-level statistical dynamical model. Meteorological Memoir No. 15.

Robert, A. and M. Kwizak, 1963: An evaluation of simple non-geostrophic forecasts. Meteorological Memoirs No. 13.

ANNEX 2: TRIBUTES RECEIVED AT HIS DEATH

Dear René,
Thank you for your E-Mail of November 19. It was indeed sad news. Of all scientists that contributed to the development of NWP, André Robert was the person that made the most significant contributions, and I am sure that he could have added even more if he had been allowed to live longer...
Sincerely.
Dr Bennert Machenhauer,
Max-Planck Institut für Meteorologie, Hamburg, Germany

René,
Very sorry to learn of André's death. I've always had great respect and admiration for him.
Dr Eric Pitcher,
Atmospheric Scientist, CRAY Research Inc., USA

Dear René,
We were all very much saddened here at ECMWF to learn of the news of André Robert's death. We, and the NWP community at large, have very much for which to be grateful to him for his life's work. We send our condolences to you all in Canada... Thanks for letting me know this sad news.
Dr Adrian Simmons,
European Centre for Medium-range Weather Forecast, Reading, England

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Cher René, (et tous les collègues de l'UQAM) :
C'est avec émotion que j'apprends le décès d'un de vos maîtres et guides, André Robert. Son oeuvre est connue en France depuis longtemps, et ses techniques très répandues. Je pense qu'il était universellement considéré comme un des pères de la prévision numérique. J'ai pu apprécier plusieurs fois (particulièrement à Tokyo en 1986, et à Denver en 1991) la clarté et le caractère incisif de ses exposés. Je suis persuadé que toutes ses idées scientifiques s'imposeront avec le temps. Je vous adresse mes plus sincères condoléances, et souhaite que son exemple continue d'inspirer votre département sur la voie de l'originalité et de la qualité. À bientôt.
Dr Philippe Bougeault,
Centre National de Recherches Météorologiques, Météo-France, Toulouse, France

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René,
I am very sorry to hear the news about André Robert's death. I have known André since my days as an MSe student at McGill (1964-66)... It would be appropriate to have a notice published in the CMOS Newsletter. I have prepared the following brief notice. Please review and send any comments. As you note, I suggest a complete notice in the next issue of the Newsletter which Howard Freeman has agreed to.

In Memoriam André Robert

It is with great regret that we note the death of André Robert on 18 November, 1993. André was an outstanding meteorologist who made great contributions to our science and to the CMOS (Canadian Meteorological and Oceanic Society). André was President of the Canadian Meteorological Society (the forerunner of CMOS) in 1974. He has the unique distinction of being the only person to receive the President's Prize twice. The first was in 1967 and was the first President's prize awarded by our new independent Society; the second was shared with his close colleague Michael Kwizak and awarded in 1971. He made great contributions to numerical weather prediction and atmospheric modelling. On behalf of the CMOS, I wish to convey to his family and all his friends, our sincere condolences. A fuller biography will appear in the next Newsletter.

Prof. Gordon McBean,
Chairman CMOS, University of BC, Vancouver, BC

René,
I've already heard about it form Terry Clark. It is very sad news indeed. I've already called David Williamson and he will notify Warren Washington and Akira Kasahara... I knew André and admired his work and wisdom. I think this is a great loss for Canadian science.
Dr Piotr Smolarkiewicz,
National Center for Atmospheric Research, Boulder, Colorado

René,
I had learned about André Robert's death this morning from Jacques Derome.
It must be quite a blow and a shock to your department.
Prof. Theodore G. Shepherd,
Physics Department, University of Toronto, Toronto, Ont.

Dear René,
Please accept Dr. Mesinger's and my condolences. I was lucky to meet Dr. Robert two years ago at the AMS Conference in Denver, Colorado. He was a wonderful man and an outstanding scientist. The Chief of NMC's Development Division is Dr. Eugenia Kalnay, but she is not here today. We'll try to inform her before Monday...
Dr Miodrag Rancic,
National Meteorological Center, Washington, DC

René,
We are indeed very sorry to hear about the sad news on André Robert. I have notified our colleagues at Florida State University. I also called Evelyn Mazur at the AMS and notified them; they will be getting in touch with RPN. We convey our deepest sympathy to our Canadian colleagues and André`s family.
Prof. T. N. Krishnamurty,
Department of Meteorology, Florida State University, Tallahassee, Florida

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Cher René,
Je te remercie te m'avoir communiqué la mauvaise nouvelle aussi rapidement que tu l`a fais. Et je sais que d'avoir à annoncer cela n'est pas une chose évidante. Ça va faire un gros trou au département physique de l`UQAM et dans la communauté en général. Je sympathise avec tous les étudiants, professeurs, et autres personnels de l'UQAM que cette mort mets dans le deuil. Ici, j'ai fait connaître la nouvelle via E-Mail. Ceux qui l'on connu sont ébranlés, comme moi d'ailleurs ...
Bertrand Denis,
Centre Climatique canadien, Victoria, BC

René,
Ce qui me fait de la peine, c'est de voir le désarroi chez un peu tout le monde. La tête de ..., qui n'est pas tellement démonstratif, était plutôt bouleversante ce matin. Puisque le gourou n'est plus là, tout ce qui reste à faire, c'est de serrer les dents et continuer. Il a probablement suffisamment donné à tout le monde pour que chacun puisse continuer. Le drame, c'est qu'on en aurait voulu encore plus parce que l'on pense qu'on en a pas eu assez. C'est finalement bien relatif. Peux-tu imaginer un type comme M. Robert mourrir à petit feu? Pas moi. Peu importe comment quelqu'un meurt, les larmes sont toujours pour ceux qui restent. Si tu as besoin d'un coup de main, ne te gènes surtout pas...
Hélène Côté,
étudiante à la Maîtrise en Sciences de l`atmosphère,
Département de physique, UQAM

René,
Jean DeGrandpré just told me the terrible news about André Robert. We're all very sorry to hear this. Its a great loss for the community... Regards
Prof. Gary Klaassen,
Department of Earth and Atmospheric Sciences, York University, Toronto, Ont.

René,
Sorry to hear about André Robert's death. He was certainly a giant of Canadian modelling.
Dr George J. Boer,
Canadian Climate Centre, Victoria, BC

Cher René,
La nouvelle de la mort d`André nous a tous profondément touchés, ceux qui le connaissaient comme ceux pour qui il représentait l`une des consciences de notre travail. De sentir ce que cela a pu nous faire d`apprendre la nouvelle à travers l`Atlantique me laisse facilement imaginer combien le choc a dû être à Montréal. Toute la P.N. (prévision numérique) se sent orpheline de celui qui avait su lui donner l`essentiel de ses lettres de noblesse, et ceux qui avaient eu la chance de le rencontrer n`oublieront ni la force de sa personnalité ni la simplicité qui émanait de tous ses gestes ou paroles. Peux-tu, s`il te plaît, te faire l`interprète pour moi et surtout pour tout GMAP/COMPAS (grande échelle moyenne échelle, application à la prévision) du sentiment de grande perte que nous ressentons et de nos condoléances pour tous ceux que sa perte touche de près. Merci de nous avoir prévenu aussi vite, même si cette nouvelle ne pouvait que nous attrister. Avec vous tous à l`UQAM et RPN.
Dr Jean-François Geleyn
au nom de beaucoup de personnes au CNRM (Centre national de recherches météorologiques, Météo-France) et SCEM.

The Pakistan Snow and Ice Hydrology Project

Bill Thompson

Canada is involved in a major program to improve the management of water resources in the Upper Indus Basin in Pakistan. The Indus River is of vital importance to the economic well-being of Pakistan. It supplies nearly all the water used for irrigation and over half of that nation's electrical energy.

The Indus originates in the Hindu Kush and Karakoram Mountains and Western Himalayas, and it traverses the length of the country crossing the fertile but arid Plains before draining into the Indian Ocean.

Two major dams, the Tarbela and Mangla, were constructed on the main stem and the adjacent Jhelum tributary, respectively, during the late sixties and early seventies at locations approximately where the rivers exit from the mountains. The irrigation and power generation systems are highly dependent on the water impounded by these dams.

Nearly all of the flow in the rivers arises from snow and glacier melt during the summer season, though a significant proportion of that entering the Mangla reservoir is created by monsoon rains during July, August and early September. The active hydrological zone lies between about 3000 and 5500 metres elevation, and knowledge of the processes taking place in the snowpack in this range is critical to estimating the flows into the reservoirs.

Canada became actively involved in 1985 when a team from Wilfrid Laurier University started conducting research on the physical processes taking place on the glaciers. This work was aided by financial support from the International Development Research Centre (IDRC).

In 1988 it was recommended that a full fledged operational system for monitoring and predicting runoff be established and a five year contract to undertake this work was awarded to BC Hydro International Ltd in 1991. Work on developing the system falls into five activity areas, namely: deployment of a network of remote hydrometeorological stations, installation of a communications system, establishment of a database management system, calibration of a streamflow model, and introduction of a forecast system. Progress in each of these areas as the Project enters its fourth year is as described below.

Installation of Remote Stations

Twenty four remote stations are scheduled to be installed. Of these sixteen have been installed, the lowest at an elevation of 2500 m and the highest at 4800 m. General areas for installing remote stations were selected on the basis of potential for runoff, elevation and access. Owing to the lack of commercial helicopters all sites must be installed and maintained by surface vehicles. The remote stations are equipped with temperature, humidity, solar radiation, wind speed and direction sensors, an antifreeze charged precipitation gauge and a 3.5 m diameter neoprene snow pillow. All sensors are read once per hour and, in addition, the temperature and wind speed and direction sensors are read every five minutes. The sensors except for the snow pillow are mounted on scaffold towers from six to eight metres above ground level to remain free of snow. The station is powered by 12 V battery and solar panel.

Communications System

The communications system was installed in July 1993 and utilizes meteorburst technology. A Master Station is located near Lahore and a terminal at each of the remote locations. The remote units transmit following each hourly reading. Communication is two-way. A recent test showed that about 70 percent of the observations reached the Master Station within five minutes, 90 percent within ten minutes and over 99 percent within one hour.

DataBase Management System

The database management system is based on CLICOM, the WMO designed system for managing hydrometeorological data. Special interface software has been developed for decoding the incoming data. This system is nearing completion but is not yet fully implemented.

Streamflow Model

The streamflow model selected to simulate flow is the UBC Watershed Model. Two sub-basins have been calibrated to date. It is expected that a total of about twelve will need to be calibrated and when completed the flows from these sub-basins will be integrated to predict flows from the entire headwaters area.

Forecast System

The Forecast System will be the last component to be implemented and it will not be put in place until 1995. In addition to the physical installations, considerable emphasis is placed on technology transfer and steps are being taken to train the staff of the Pakistan Water and Power Development Authority (WAPDA), the local agency which will eventually operate the System. Provision has been made for three WAPDA staff to take the M. Sc. program of studies in Engineering at UBC. To date one person has completed the program and a second is in attendance.

(Project Manager is Dr. Warren Bell. Site Manager is Bill Thompson. Mr. Thompson is located in Lahore, Pakistan.)

Summary of the 1994 *CMOS Tour Speaker*

by
Andrew Staniforth

My cross-country visits as the CMOS Tour Speaker were both challenging and rewarding. The Tour provided a great opportunity to visit all of the Society's Chapters across the Country, and to meet its members and find out more about what they are doing. I gave my talk, with variations depending on local interests, at 14 Chapters during a one-month period ending March 31st. The choice of period was a compromise between delaying the Tour to the last minute to maximise the likelihood of clement temperatures for travelling (and my tendency to procrastinate), and completing it before the end of the fiscal year (March 31st) to respect funding constraints. The Tour started on February 28th with the six most-westerly Chapters: Vancouver, Victoria, Calgary, Edmonton, Saskatoon and Winnipeg.

The Vancouver Chapter had the dubious distinction of acting as "guinea pigs" to "debug" the talk for the presumed benefit of the other Chapters.During this "western swing", I visited three universities (UBC, Victoria and Saskatoon), four weather service centers (in Winnipeg), and two government labs (Sydney, BC, and Saskatoon). It certainly made for a very full week.

A typical day consisted of interacting with people at a couple of centers, and giving my talk at some point, followed by travel to my next destination during the evening. It gave me a very real appreciation of really just how significant the geographical extent of Canada is when I finally made it to my hotel room in the late evening! I was very fortunate with both the weather and airline punctuality (with the suspicion that the latter was a consequence of the former). It turned out that the weather was as clement for the time of year as it has been in many years,with a veritable inland heat wave!

The following two weeks were comparitively relaxed, with a visit to Toronto (Downsview) one week, and Ottawa the next. Particularly noteworthy for the Downsview visit was the determination and interest displayed by two retired members, both of whom regrettably suffer from serious health problems. Barney Boville is recovering from a stroke and attended the talk in a wheelchair. Gibb Henry was too ill to attend, so the Toronto Chapter kindly videotaped my talk and provided him the tape! I think this speaks highly of both the Society and its Members, and I am sure all members will join me in hoping that the health of both will greatly improve.

My visit to the Ottawa Centre was the only one affected by the weather, and necessitated driving through a minor snowstorm to get there. While in Ottawa I briefly visited Ice Branch before venturing out into the snow again.

The fourth week I undertook the first of two "eastern swings", visiting the weather service centres in Fredericton and Halifax, and Memorial University in St John's, Newfoundland. While planning the eastern swings I discovered that not all eastern cities are connected by straightline airpaths, which caused a few logistic problems for scheduling.

The fifth week, I switched the language of my talk to French, and successively visited two oceanographic institutes in the Rimouski region, and the weather centres in Québec City and Montréal, finishing in Montréal in the afternoon before Good Friday.

The Tour provided an excellent prelude to a most restful Easter weekend! After I had sorted my transparencies after Easter and put them away, I was then invited to give a version of my talk to the AES Directors' meeting in Trenton, which I did towards the end of April. I think that will prove to be the last in the series, but I've learnt that one can never be sure!

All told the Tour involved giving a talk in 15 different cities located in 10 different provinces from one coast to the other. It served to confirm that Canada is a big, beautiful and varied country with a very friendly and hospitable population, particularly its CMOS members. As a consequence, I owe a debt of gratitude to many people and organizations.

I would like to thank the CMOS executive for inviting me to be the 93/94 Tour Speaker, and Environment Canada and Fisheries & Oceans for generously providing the necessary funding to make this possible. Arranging a schedule and making Td anticipated, and I am greatly indebted to all my Chapter hosts and their Executives for their flexibility, understanding and hospitality. I am particularly indebted to our local secretary, Diane Lespérance for making and coordinating my travelling arrangements, many of which had to be done during my absence on business. Finally, and most importantly, I would like to thank the CMOS membership. It was your friendliness, interest, questions, feedback, interaction etc. that made it such a personally rewarding experience.

The large relative turnout at all Chapters, is an excellent indicator of the vigor of our Society for which we should all be justly proud. As a meteorologist, I was particularly impressed by the attendance and interest shown by the oceanographic community. I was also impressed by the turnout at the smaller centers, such as in Calgary, Quebec City, Fredericton and Newfoundland, where it is much more difficult to achieve critical mass.

Although the Tour did require significant time and energy, the rewards were well worth the effort and I heartily recommend the experience to future speakers.

CMOS E-Mail Addresses

In the CMOS Newsletter 21(6) I invited members to send their E-mail addresses to me if they wished to be in a general CMOS listing. The following are the addresses received so far; the response has not been overwhelming. If you wish to have your name added, then please send your address to Howard Freeland at the Internet address listed below, and using the format of the entries listed. Place name, affiliation

and E-mail address on a single line and write "E-mail address" in the subject field of the message. An updated list will be printed as seems necessary.

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SATELLITE REMOTE SENSING OF THE OCEANIC ENVIRONMENT,

Edited by I.S.F. Jones, Y. Sugimori and R.W. Stewart,
528 pages,Seibutsu Kenkyusha,
Tokyo, Japan

by

Arthur P. Cracknell
University of Dundee

This is a very unusual book from the authorship or publishing point of view. We are all familiar with books written by one author or by a set of two or three authors. On the other hand we have also encountered books where individual chapters have been written by various contributing authors and we are familiar with edited sets of papers from a conference, workshop or other similar meeting. We also all know that the first kind of book usually provides a homogeneous and systematic treatment of a subject, whereas edited collections of contributions are much more heterogeneous and may be much patchier in the coverage of a subject. This book does exist as a result of a conference, the First Pacific Ocean Remote Sensing Conference, which was held in Okinawa, Japan, but I do not recall seeing anything quite like it before. Perhaps it is best described in the editors' own words from the Preface. They say, "The book is not a collection of papers given at the Conference. Rather a number of people, each a leader in the field, volunteered to co-ordinate chapters and to choose papers appropriate to that theme. Chosen papers are rewritten by the authors, and each chapter was provided with an introduction designed to supply a background for those not yet fully familiar with the particular aspect of remote sensing discussed in the chapter. Such an approach is a little unusual and its success will be judged by the reader. One hundred and ten authors contributed their knowledge, many in electronic form.

Thus the appearance of the book is just like that of a conventional textbook or monograph with one exception; this is that individual sections have, on the right-hand side of the section heading, the name of the author(s) responsible for that section. If other people start citing these individual sections among their lists of references under the names of the contributing authors it is going to lead to a bibliographical nightmare! To give the flavour of that is involved I quote, randomly, the section headings of chapter 6 which is on Marine Wind:

6.1 Introduction: A. Brown
6.2 Wind vectors from SSMI: Frank Wentz
6.3 Variability of winds in NW Pacific: H. Kawamura
6.4. A comparison of wind fields from ships and SSMI: H. Kutsuwada
6.5 Comparison of Geosat winds from SSMI and ECMWF winds: M. Kubota
6.6 Surface wind variability from satellite Side Looking Radar: Leonid Mitnik

The result is rather curious. Let us consider the topic of near-surface wind speeds as an example. A standard textbook, such as Methods of Satellite Oceanography by R.H. Stewart (one of the editors of the present volume) for example, would be expected to cover the use of synthetic aperture radars, altimeters, scatterometers, passive microwave radiometers, dekametric (ground-based) radars and real aperture (side-looking) radars for wind studies. What we have in this volume is a brief mention, in chapters 4 and 5, of altimeters and scatterometers in connection with wind-speed determination, but a very extensive discussion in chapter 6 (see above) of passive microwave radiometry (mainly from SSM/I) and some discussion of the use of real-aperture radar.

Let me take another example. Perhaps one of the greatest successes of satellite oceanography is the use of thermal infrared scanners for the determination of sea surface temperature. Textbooks such as the one by Stewart which I have already mentioned, or Satellite Oceanography by I.S. Robinson, give extensive accounts of this important subject. In the present book there are various points at which sea surface temperatures determined from satellite infrared data are discussed, but nowhere will the reader find a systematic account of this aspect of the subject. Chapter 2, which is entitled Visible band radiometers actually has more pages devoted to the use of infrared data than to the use of visible data, but it follows the same pattern as I have already described in connection with winds. Thus, for instance, section 2.2 entitled "The relationship between skin and bulk sea surface temperatures" by W.J. Emery et al. follows very closely a recent paper by these authors in the J. of Geophys. Rese., while section 2.5 is entitled "Warm eddy detection from AVHRR thermal images using the Hough transformations" all in a chapter entitled Visible band radiometers (when what they mean is visible and infrared scanning radiometers!). This is fine if one already has a good understanding of the use of the AVHRR thermal bands for sea surface temperature determination and wants to find out what is new in the last five years or so.

In other words, what is presented in this book is based on the assumption that the reader has read the standard textbooks written 5-10 years ago and this book now presents, in textbook style, results of rather recent work and the use of systems that only became available rather recently. So long as one understands that this is the case, the book is fine. But if a student picks up this book in a bookshop or library and thinks that it is a balanced text on satellite oceanography he or she will be misled. This aspect is alluded to, but not identified very explicitly, in the Preface to the book: "In the course of planning the Conference, it was decided that a monograph should be produced that would be of both immediate interest and of lasting value: immediate interest because it contains the results of the most recent research and lasting interest because it attempts to cover a broad sweep of satellite remote sensing." The last phrase must not be interpreted as suggesting that the book gives a balanced account of the field of satellite oceanography. It does not.

What I object to in this book is that it masquerades as a textbook on the subject. While it is much more

homogeneous, balanced and systematic than a conference proceedings, it is not a balanced textbook of the subject. It is actually a textbook for someone who knows more or less what the state of the art was, say, 5 years ago and who wants to find out what is new since then.

Having said all the above and once one understands what the true nature of the book is, then one can quite fairly say that it is an excellent production. I know from my own experience of trying to edit conference proceedings that persuading contributors to deliver their material is extremely difficult. To persuade people not only to deliver material but to undertake a considerable task of rewriting and synthesis, as has been done for this book, is truly remarkable and a very fine achievement.

I picked out two topics, near-surface wind speeds and sea surface temperatures to illustrate my main point. I should perhaps say a little more about the contents of the book. The introduction contains a very sketchy outline of the history of remote sensing of the oceans; the reader would do better to read one of the textbooks on the subject. The next four chapters are devoted to visible (and infrared) band scanning radiometers, passive microwave scanning radiometers, satellite radars (SARs and scatterometers) and radar altimeters. Chapter 6 on Wind has already been mentioned. Chapter 7 on Radiation Processes and Climate shows a lack of balance similar to that already noted on other topics. If one has read the IPCC Report of 1990 on Climate Change and wants to know what is new in terms of aerosols, and especially about clouds of volcanic ash and dust, it is fine. But it does not give a balanced account of the use of satellite remote sensing in connection with radiation processes and climate; the role of clouds in climate occupies 4 pages and the role of aerosols covers 13 pages! I would analyse the remaining chapters, which cover air-sea interaction, wind waves, ice, ocean currents, biological processes and land-ocean interactions and identify similar lacks of balance; but to do so would detract from the real value of the book. It does form a valuable contribution to knowledge and it will be of more enduring value than the typical conference proceedings publications.

What's Going Around
by
Savonius Rotor

I have noticed that there is an entirely new class of error creeping into the English language. This new type of error arises from the use of spell checkers on Word Processors, or perhaps I should call these tools "spill chequers". These tools are, of course, supposed to check that a word is spelled correctly. They don't actually do that at all, they actually check that a word is in the dictionary, which is entirely different. The meaning of a sentence can change dramatically if a word is mis-spelled and by chance an alternative English word is found. I have made a small collection, with comments, and would welcome any other genuine errors that may have been found by my readers. One intriguing question does spring to mind, is this phenomenon unique to the English language?

The Victoria Times Colonist has produced two gems that appeared on the front page. In the first it was reported, following an explosion that resulted from a leak in a natural gas pipeline that, "The explosion shattered several nearby widows." Of course, perhaps in this case no error was actually made. In the second example from the Times Colonist, the front page carried a photograph of a lone rower moving briskly across Elk Lake, the caption reported that he was preparing for competition in "single skulls". Doubtless he was aiming to win the prestigious Yorick Prize. My daughter contributed an example from a geography text book in which the languages of an African country were described as "English (official) and African-French patios." Finally, I contribute a Canadian Government example. "The Sounder" is a magazine published by DFO Pacific Region and describes what is going on in this region for the benefit of employees. A recent issue (Volume 30, number 4) carried a photograph with the caption, "A picnic by the sea for West Van Lab and Cost Guard Staff." Perhaps this was in fact a sly commentary on plans by the Canadian Coast Guard to cut costs by automating BC Light Stations.

Ice breaker night of the CMOS congress: Drs Ken Yuen and Gordon McBean

CMOS AND THE NEW PROPOSED DEFINITION OF ENGINEERING

by

Ambury Stuart

Why should CMOS or other scientific societies be interested in how engineers define engineering? This was the first question that occurred to me when I was asked to represent CMOS at meetings between several scientific societies and the Canadian Council of Professional Engineers (CCPE). The CCPE is a national organization which advises the various provincial engineering bodies in Canada and had recently proposed changes in the definition of the "Practice of Professional Engineering". Under the BNA Act it is the provinces who regulate professions in Canada, and it is therefore the provincial engineering orgainzations, working with provincial governments, who are ultimately able to define and regulate the Practice of Professional Engineering in Canada.

As technology changes, all technological professions must evolve and adapt in response to these changes. For example, computer programming is now a commonplace activity of both scientists and engineers, and computer programming courses are included in both science and engineering curricula. Even if a distinct dividing line once existed between science and engineering, this line must become blurred as new technologies are introduced, and both engineers and scientists move to take advantage of these technologies in the course of practising their respective professions. This can be a source of serious difficulties for scientists since the Practice of Professional Engineering, once enshrined in an Engineering Act by a provincial government, is an exclusive practice, and can only be carried out by persons licensed by the provincial engineering association as qualified to carry on such a practice. If for example, an Engineering Act were to state that the Practice of Professional Engineering included the development and issuing of weather forecasts, then only those individuals certified as professional engineers could issue a weather forecast. Those who defied the Engineering Act could be convicted of being in violation of this Act and in Ontario for example, would come under the following clauses:

> *No person shall offer to the public or engage in the business of providing to the public services that are within the practice of professional engineering except under and in accordance with a certificate of authorization.*
>
> Ontario Professional Engineers Act, Section 12(2)

> *Every person who contravenes Section 12 is guilty of an offence and on conviction is liable for the first offence to a fine of not more than $15,000, and for each subsequent offence to a fine of not more than $30,000.*

Science and Engineering are very closely related and given these penalties, it behooves all scientific societies to ensure that provincial Engineering Associations do not so widely define Engineering Practice that they include activities that may be carried out by a natural scientist.

So what is defined to be the Practice of Professional Engineering now? Each province's Engineering Act is different, but the following was recommended to the Ontario legislature in 1984:

"Practice of Professional Engineering" means:

> *Any act of designing, composing of plans and specifications, evaluating, advising, reporting, directing or supervising wherein the safeguarding of life, health, property or the public welfare is concerned and that requires the application of engineering principles.*

Does this definition include weather forecasting? A close reading of the definition shows that three tests must be applied to determine if any activity falls within this definition of the Practice of Professional Engineering. First, Professional Engineering is any act of "designing, composing of plans and specifications, evaluating, advising, reporting, directing or supervising". It certainly may be argued that weather forecasters (and most other scientists for that matter) evaluate, advise and report, and they or their managers direct and supervise. So this test is passed. The second test requires that the activity concerns "the safeguarding of life, health, property or the public welfare", and weather forecasting certainly passes that test. The final test requires that the activity "requires the application of engineering principles", and since the other two tests have been passed all would seem to depend on how broadly this definition is made. For example, do Engineering Principles include Newton's Laws and the Laws of Thermodynamics? Unfortunately for the scientific community, the engineers will argue that the answer to this question is Yes! What this definition of Engineering Practice essentially means is that any scientific activity that has any impact on the public is defined to be engineering and falls within the scope of this Engineering Act.

Obviously, this definition is far too broad, but it would have been applied in Ontario in 1984 had it not been for the watchfulness of the Canadian Association of Physicists (CAP), who opposed the definition when it was before the Ontario legislature, eventually appearing before the Legislative Committee studying the Bill. As a result of the intervention by CAP, the Ontario definition was revised by the addition of the following clause: *"but does not include practising as a natural scientist."*

This exemption for natural scientists is in force only in Ontario, and scientists in other provinces have no similar legal protection for the practice of their professions. No engineering association has yet objected to the delivery of weather forecasts by non-members of their profession, but any reasonable reading of the various Engineering Acts outside Ontario must conclude that any scientist whose work affects the public is in violation of the Engineering Act for his/her province. This state of affairs is clearly unacceptable, not only to weather forecasters but also to a very large number of other disciplines.

In 1990 the CCPE established a committee to produce a national guideline for a revision to the definition to the Practice of Professional Engineering. Their recommendation, and its variance from the current Ontario definition is as follows: (additions to the present wording are highlighted and deletions are stroked out)

"Practice of Professional Engineering" means

> Any act of **planning,** designing, composing, ~~of plans and specifications,~~ evaluating, advising, reporting, directing or supervising **or managing any of the foregoing** wherein the safeguarding of life, health, property, **economic interests** the public welfare or **the environment** is concerned and that requires the application of engineering principles ~~but does not include practising as a natural scientist.~~

This definition is even less acceptable to natural scientists than its predecessor in Ontario. First, planning and management are specifically added to the other acts that compose engineering and any limitation implied by "of plans and specifications" has been deleted from the act of composing. Secondly, in addition to the safeguarding of life, health, property and the public welfare, engineering is now also to including the safeguarding of economic welfare and the environment. Finally, and of great importance, the exemption for natural scientists included in the Ontario Act is not included in the new CCPE definition.

As was the case in 1984, the CAP has again taken the lead in the opposition to this new definition of the Practice of Professional Engineering. Thirteen scientific societies including physicists, mathematicians, statisticians, biologists, chemists, computer scientists, meteorologists and oceanographers have joined together to form the Natural Sciences Societies of Canada (NSSC) in opposing this initiative from the CCPE. CMOS is a member of NSSC, and I represent our society in their activities. Since October, 1993, NSSC has had ten meetings and two joint meetings with representatives of the CCPE. We have also submitted a brief entitled "The Regulation of Occupations in Technology" which was presented to the Law Reform Commission of Manitoba and has been subsequently endorsed by eight member societies (including CMOS) and by the Physics Department of the University of Manitoba. This brief has also been distributed to the governments of BC, Alberta, Saskatchewan, Yukon and Ontario where action to revise the definition of Engineering Practice is known to be in the hands of each of these governments. Numerous letters calling for a broad review of any revisions to the Practice of Professional Engineering have been sent by our Chair, Ann McMillan, to representatives of government across Canada, while the development of a natural sciences exemption clause acceptable to both NSSC and CCPE has been attempted, and is the subject of continuing negotiations with the CCPE.

At the recent meeting of the CMOS Council during the Ottawa Congress, the Council officially endorsed our participation in NSSC and authorized me as your representative to continue to support NSSC in its attempt to call for a broad review of any proposed revisions to any of the provincial Engineering Acts. Council also asked that this article be written for the CMOS Bulletin to apprise the membership of the activities of NSSC and to call for support of the membership in these activities.

Anyone who has persevered to this point should now have some idea of the issues at stake here and why we should be concerned. These issues are bound up in legalese and are somewhat subtle in their implications. The intent of the changes proposed however, are reasonably clear; engineering associations want to redefine the practice of professional engineering so that new study areas developed by changing technologies will automatically fall within their purview without the necessity of further amendments to the Engineering Act. The problem with this is that these changing technologies also affect non-engineers, who also need to be considered in any legislative process that defines an exclusive practice.

I would now like to bring to the attention of CMOS members in Nova Scotia a recent development that affects them directly. At a meeting of NSSC held since the CMOS Congress, a working draft of a new Engineering Professions Act for Nova Scotia was circulated (a copy of this document will be forwarded to the Nova Scotia CMOS Executive by the time this article appears). This draft contains the most aggressive incursion seen so far by NSSC by any engineering association in the country. Under a "Technical and Allied Activities" section any "professional, technical or scientific field or area which is related or allied to engineering or geoscience" can be explicitly brought under all the other terms of the Engineering Professions Act. There would be no necessity to prove that oceanography for example, fell under the definition of engineering practice, since the practice of oceanography could now be made directly subject to the Act. To include oceanographers or any other discipline throughout natural science, the Act only requires that some association of the appropriate specialists vote to come under the Act. There appears to be no requirement that this association be representative of all the specialists in the province; it presumably could be composed of a very small group of people. NSSC regards this as a very dangerous precedent, and will continue to monitor its progress and call for a broad review by all interested parties in Nova Scotia. We strongly recommend that CMOS members living in Nova Scotia become familiar with this issue, and make their views known to their scientific colleagues and the approprite authorities now dealing with the revision of the Enngineering Professions Act in Nova Scotia

GEWEX UPDATE: Green Plan funding for 1994/95

Members of the Canadian GEWEX Science Committee met on March 16, 1994 at AES Headquarters in Toronto to complete the review of the proposals which had been submitted by government researchers for GEWEX Green Plan funding for the fiscal year (FY) 1994/95. In attendance were H-R Cho (Univ. Toronto, Chairman), D. Gray (Univ. Saskatchewan), W. Rouse (McMaster Univ.), R. Soulis (Univ. Waterloo), P. Marsh (NHRI, Saskatoon), R. Stewart (AES, Downsview), D. Verseghy (AES, Downsview), L. Welsh (AES, Saskatoon), and T. Krauss (Secretariat).

Twenty-five (25) proposals totalling $1.1 million were reviewed by the Science Committee. All of the proposals were in a standard format following the modified NSERC form F137 which was adopted last year. The standardization of proposals between university and government researchers has been facilitated by using this common form. Each reviewer was asked to provide comments on the following aspects of the proposed research with respect to a single, integrated Canadian GEWEX program: scientific content and originality, anticipated significance and contribution, clarity and focus of objectives; methodology, and feasibility.

Based on the review and recommendations by the Science Committee, the GEWEX Management Committee approved the allocation of $350,000 to 20 projects for 1994/95 at a meeting held on May 12, 1994. The Management Committee consists of Dr. J. Stone, (AES, Downsview), R. Halliday and Dr. W. Nicholaichuk (NHRI, Saskatoon), and R. Lawford (AES, Saskatoon). The allocation of Canadian Green Plan funds is as follows:

- AES Dorval, RPN: $72,000 for realtime mesoscale modelling during BASE and for the development of a global numerical weather prediction system for GEWEX.
- AES Dorval, CMC: $8,000 for satellite observations during the Beaufort and Arctic Storms experiment (BASE).
- AES Downsview, Climate Research Branch: $47,000 for special research aircraft flights for GEWEX during BASE and for the study of frontal clouds over the Mackenzie Basin.
- AES Downsview, Climate Research Branch: $21,000 for implementation of improved precipitation measurement methodologies and application of satellite evapotranspiration studies.
- AES Downsview, Cloud Physics: $33,000 to support a radar observation program during BASE and for further development of cloud-precipitation-temperature relationships for the Mackenzie GEWEX Study (MAGS).
- AES Saskatoon, Climate Research Branch: $27,000 for moisture budget analyses, and mesoscale distributed precipitation modelling for MAGS.
- Inland Waters Directorate, Yellowknife: $8,000 for Mackenzie mainstream and delta simulations.
- NHRI, Saskatoon: $90,000 for hydrological process studies involving snowcover removal and development in boreal and tundra ecosystems, hydrologic responses of discontinuous permafrost and wetland zones, and glacial runoff contributions.
- NHRI, Saskatoon: $30,000 for hydrological modelling within the Mackenzie Basin.
- NHRI, Saskatoon: $14,000 for remote sensing studies of evapotranspiration and monitoring of snowmelt in northern watersheds.

For further information about the Canadian GEWEX program, contact Dr. Terry Krauss, National Hydrology Research Centre, 11 Innovation Boulevard, Saskatoon, SK S7N 3H5. Tel: (306) 975-4215, Fax: (306) 975-5143, e-mail krausst@nhrisv.nhrc.sk.doe.ca

A new CMOS Tradition
1st J.P. Tully Medal Luncheon

During the last CMOS Congress in Ottawa, the oceanographers held the first J.P. Tully Medal Luncheon on Thursday, June 2, 1994. The Tully Medal, initiated only a few years ago, honours the contribution of an imminent oceanographer in Canada. This year, the Medal was awarded to Dr. Cedric Mann for his long time contribution to oceanography. Organized by Ken Yuen, this first luncheon was a deliberately informal affair at a friendly neighbourhood pub near Ottawa University. A number of CMOS members attended the luncheon: Drs. Paul LeBlond from the Vancouver Chapter and Larry Mysak at McGill University; Drs. Peter Smith and Fred Dobson from the Halifax Chapter; Geoff Holland and Dick Stoddart from the Ottawa Chapter. During the luncheon, after having congratulated Ced Mann for this honour, Ken Yuen could not resist the temptation to address the audience in a long awaited speech on "The good feelings of being an oceanographer ... in Ottawa"! Also among the participants, a previous recipient of the Tully medal, Dr. Neil Campbell and his wife Eleanor. The oceanographers attending this year's luncheon are still debating how Geoff Holland got to the restaurant last, ate first and was ahead of everyone else outside the premises. One famous quote is from Jim Powell who missed the luncheon because he was busy with the scientific program of the Congress: "Gee, I've missed it"! Next year, Jim, in Kelowna!

Paul-André Boldue

CMOS Member takes up Director's position in Australia

Dr. T.S. (Tad) Murty, a senior research scientist at the Institute of Ocean Science (IOS) in Sydney, British Columbia, is moving to Australia to become the Director of Australia's National Tidal Facility located at Flinders University in Adelaide. In his new position, Murty will be coordinating research activities on the analysis of tide gauge records and sea-level observations over the southern Indian Ocean and the south Pacific oceans encompassing Australia and eleven island countries in the region. The thrust of this research activity is to detect global change (global warming) signal and to monitor various phases of ENSO (El Niño/Southern Oscillation) events.

Murty has been with the Department of Fisheries of the Federal Government of Canada for almost 27 years, the last 17 of which with the IOS in Sidney. Murty has a long publication record which includes four books and well over one hundred journal papers and reports. His books on Tsunamis (published in 1977) and storm surges (published in 1984) have become important source material for many researchers in these fields. Murty has been an active member of the CMOS for over 20 years and was the Secretary of the CMOS Scientific Committee from 1989 to 1992. Murty was awarded the CMOS prize in Oceanography in 1985 and earlier in 1975 received a Public Service of Canada Incentive Award for his "exceptional and distinguished contributions" to mathematical modelling of physical oceanographic problems, including prediction of the movement of icebergs and oil slicks. Murty obtained his first M.Sc. degree (1959) in Meteorology and Oceanography from Andhra University in India. He went to U.S.A. as a graduate student and joined the University of Chicago where he obtained his M.Sc. (1962) and Ph.D. (1967) in Meteorology under the supervision of professor Dave Fultz and George W. Platzman. Murty immigrated in Canada in 1967 and has been with the Department of Fisheries and Oceans ever since.

Postdoctoral positions at the Centre of Climate and Global Change Research (C^2GCR) McGill University

C^2GCR is a multidisciplinary research centre based at McGill University, and includes participation from Université du Québec à Montréal. Centre members invite applications for four post-doctoral positions in the areas of a trace gas biochemistry and ecosystem-atmosphere interaction (Drs. T. Moore and N. Roulet); (b) subgrid-scale processes in ocean-climate models (Drs. D. Straub and L.A. Mysak); (c) radiation, clouds and aerosols and Arctic climate modelling (Drs. R. Davies and J-P. Blanchet); (d) atmospheric circulation anomalies and hydrologic cycles in global climate models (Drs. J. Derome and C.A. Lin).

We seek candidates with a Ph.D. degree in meteorology, oceanography or a related field. Initial appointment will be for 1 year, at a minimum annual salary of $28,000. Candidates should send by September 15, 1994, a curriculum vitae, a statement of research interests, a list of publications, and arrange to have three letters of reference sent to Ann Cossette, Centre of Climate and Global Change Research (C^2GCR), McGill University, 805 Sherbrooke Street West, Montréal, Québec, Canada H3A 2K6. The starting date is negotiable.

Poster session at the 28th CMOS congress: Drs. Michel Danilin and Jack McConnell

THE 28th CMOS CONGRESS
MAY 30 - JUNE 3, 1994

Nearly 300 scientific papers were submitted to the Congress and were accepted in oral and poster sessions.

Part of the success of the Congress was due to the decision, taken several months before, to accept joint sessions with the Canadian Society of Agrometeorologists and with the aviation meteorologists. Both of these interest groups joined with the Scientific Program Committee and nominated representatives to be responsible for their respective sessions.

With the location of the Congress being the National Capital, the Scientific Program Committee early on decided to relate science to identifiable issues and hence chose the Theme for the Congress as "Science - Addressing the Issues". For the same reason of location the Program Committee also decided to depart from the traditional use of the first day for CMOS and related meetings and to have a non-technical discussion of Global Change with a high-level calibre of public speakers. This change necessitated some scheduling of meetings to the evenings and even on the previous Sunday, but the success of the Global Change Forum, and the interest shown by the participants, made the effort well worthwhile.

Throughout the technical part of the week, four sessions were held concurrently. Chairmen were strongly encouraged to keep a strict schedule so that participants were able to move between sessions if they wished to listen to specific papers. The closeness of the various meeting rooms also allowed for this sort of mobility.

The poster sessions were particularly well received, time being set aside during part of the Congress to allow for poster authors and participants to interact.

In all, the quality and quantity of the presentations were excellent and the 28th Congress will go down as a resounding success.

Geoff Holland
Chair, Scientific Program Committee

Le 28e Congrès de la SCMO
30 mai au 3 juin 1994

Près de 300 exposés ont été soumis et acceptés comme présentations orales ou sous forme d'affiches au Congrès.

Un bonne partie du succès du Congrès vient d'une décision prise plusieurs mois auparavant d'accepter des sessions conjointes avec la Société canadienne d'agrométéorologie et de la météorologie de l'aviation. Ces deux groupes d'intérêt se sont joints au Comité du programme scientifique et ont élu des représentants responsables de leurs sessions respectives.

Le Congrès de cette année ayant lieu dans la Capitale nationale, le Comité du programme Scientifique a décidé très tôt de mettre en relation la science avec des questions de tous les jours et a donc choisi comme thème du Congrès: « Les Sciences: des solutions aux problèmes ». Pour la même raison, le Comité a également choisi de déroger aux traditions de la Société où la première journée du congrès est habituellement consacrée à de multiples réunions. Le Comité a donc organisé une discussion à caractère non technique sur les changements à l'échelle planétaire en invitant des conférenciers de marque. Ce changement a nécessité un tout nouvel agenda où les réunions habituelles se sont tenues le soir ou même le dimanche précédent, mais le succès remporté par le Colloque sur les changements à l'échelle planétaire et l'intérêt démontré par les participants ont justifié tous nos efforts.

Durant la partie technique des quatre derniers jours, il y a eu jusqu'à quatre sessions simultanées. Nous avons insisté pour que les présidents des différentes sessions respectent un horaire très strict de sorte que les participants pouvaient se déplacer d'une session à une autre pour pouvoir écouter un conférencier particulier. La proximité des salles a grandement facilité cet arrangement.

Les exposés sous forme d'affiches ont connu un grand succès. Une période de temps particulière fut allouée pour permettre une bonne interaction entre les auteurs et les participants.

D'une façon générale, la qualité et la quantité des exposés fut excellente et le 28^{e} Congrès passera à l'histoire comme un vibrant succès.

Geoff Holland
Président, Comité du programme scientifique

PRELIMINARY REPORT FROM THE 28th CONGRESS

The 28th CMOS Congress closed its five-day session in Ottawa on June 3. The Global Change Forum, held on the first day at the Government Conference Centre, was an outstanding success with presentations, among others, by Stephen Lewis, Maurice Strong and William Rees. Preliminary indications point to a successful Congress on the scientific side (236 oral presentations plus 41 poster papers) and also on popularity (over 300 registrants + 11 commercial exhibitors). Now that the Congress is over, our treasurer is busy paying all the bills and hopefully, there will be a sizeable surplus when this is completed!

A breakdown of registration shows 136 CMOS members, 67 non-members, 70 students and 232 one-day registrants. It is encouraging that CMOS activities generate significant interest among the students and in the scientific community outside current membership.

A strict categorization of presentations would be lengthly and can be found in the "Program and Abstracts" distributed early June to all CMOS members. But generally speaking, 33% of the presentations were on meteorological topics, 14% on Middle Atmosphere Models, 13% on Aviation Meteorology, 9% on Oceanography, 7% on Agriculture and Forestry Meteorology, 3% on Fisheries Oceanography, and finally, 7% interdisciplinary. More than 15% were posters papers.

Both the Scientific Program and Local Arrangement Committees wish to thank all those inside and outside of CMOS who came together to make the 28th Congress a success. Organizers of the 29th Congress were in Ottawa in force to learn from our experience. They appear to be enthusiastic and eager to organize next year's Congress in Kelowna, B.C.

Paul-André Bolduc.
Communications/Local Arrangement Committee.

RAPPORT PRÉLIMINAIRE DU 28^{e} CONGRÈS

Le 28^{e} congrès annuel de la SCMO qui a eu lieu à Ottawa s'est terminé le 3 juin après une semaine complète d'activités. Le Colloque sur les changements à l'échelle planétaire, tenu le premier jour au Centre des conférences du gouvernement, a connu un grand succès avec des présentations, faites par ente autre Stephen Lewis, Maurice Strong and William Rees. Les premières indications révèlent un franc succès sur le plan scientifique (236 présentations orales plus 41 affiches) et montrent également sa très grande popularité (plus de 300 inscriptions + 11 exposants commerciaux). Présentement le trésorier du congrès a beaucoup de factures à payer, et on espère qu'il nous restera un surplus appréciable une fois que tous nos créanciers seront satisfaits.

Un rélevé des inscriptions montre qu'il y avait 136 membres de la SCMO, 67 non-membres, 70 étudiants et 232 inscriptions pour une seule journée. C'est très encourageant de constater que les activités de la SCMO suscitent tant d'intérêt chez les étudiants ainsi qu'auprès de la communauté scientifique qui n'est pas encore membre de notre Société.

Une description précise des différentes catégories des présentations serait fastidieuse et peut être trouvée dans le « Programme et Résumé » distribué à tous les membres au début de juin. Mais d'une façon générale, on peut dire que 33% des présentations touchaient la météorologie, 14% la modélisation de l'atmosphère moyenne, 13% la météorologie de l'aviation, 9% l'océanographie, 7% la météorologie de l'agriculture et des forêts, 3% l'océanographie des pêches, et enfin, près de 7% étaient de nature interdisciplinaire. Plus de 15% des présentations furent faites par affiches.

Le comité du programme scientifique et le comité local d'organisation désirent remercier tous ceux et celles, à la fois les membres et les non-membres, pour leur contribution au succès du 28^{e} congrès. Les organisateurs du 29^{e} congrès étaient présents à Ottawa en grand nombre pour se familiariser avec les multiples rouages de la tenue d'un tel congrès. Ils semblent enthousiastes pour l'organisation du prochain congrès qui se tiendra à Kelona, C.B. -

Paul-André Bolduc,
Communications,
Comité local d'organisation

1994 CMOS Awards

The banquet for the 28th CMOS congress was held Thursday June 2 in the elegant Chateau Laurier. As usual the presentation of the 1994 CMOS Awards and Prizes was the highlight of the event. The following members were recognized for their contribution to the science of Meteorology and Oceanography:

Prix CMOS 1994

Le banquet du 28e congrès CMOS se tenait le jeudi, 2 juin, au Château Laurier. La présentation des prix et récompenses a été comme d'habitude, l'événement marquant de la soirée. Les personnes suivantes ont été reconnues pour leur contribution à la science de la météorologie et de l'océanographie:

President Prize: Awarded to Dr. Gordon E. Swater of the University of Alberta for his contribution to the understanding of the dynamics of the atmosphere and the oceans.

Le prix du président, fut décerné au Dr. Gordon E. Swater de l'Université de l'Alberta pour sa contribution dans la compréhen-sion de la dynamique de l'atmosphère et des océans.

Tully Medal: Awarded to Dr. Ceric R Mann for his scientific leadership of Canadian physical oceanographic research programs for over three decades.

La médaille Tully fut décerné au Dr. Cedric R. Mann pour son leadership scientifique dans les programmes de recherches canadiens en physique océanographique, pour plus de trois décennies.

Jim Bruce receiving life time membership.

Jim Bruce a reçu un titre de membre à vie de la SCMO.

Dr. Andrew Thompson Prize in Applied Meteorology: Awarded to jointly to Dr. Andrew Staniforth and Jean Côté of the Atmospheric Environment Service at Dorval for their significant long term contributions to the improvement of meteorological forecast models.

Le prix Dr. Andrew Thompson en météorologie appliquée fut décerné conjointement aux Dr. Andrew Staniforth et Jean Côté du Service de l'environnement atmosphérique à Dorval pour leur contribution significative à long terme dans l'amélioration des modèles de prévisions météorologiques.

Graduate Student Prize-Meteorology: Awarded to Dr. Richard Ménard of McGill University for his highly original contribution to the use of Kalman Filtering in atmospheric data assimilation.

Le prix pour un étudiant gradué en météorologie fut décerné au Dr. Richard Ménard de l'Université McGill pour sa contribution originale dans l'utilisation de la technique de filtration Kalman dan l'assimilation de données atmosphériques.

Prize in Applied Oceanography: Award to Dr. Madhav L. Khandekar of the Atmospheric Environment Service for his important contributions to the application of analysis and prediction methodology for ocean wind waves.

Le prix d'océanographie appliquée, fut décerné au Dr. Madhav L. Khandekar du Service de l'environnement atmosphérique pour son importante contribution à l'application de méthodologie à l'analyse et la prédiction des vagues océaniques

Graduate Student Prize-Oceanography: Dr. David M. Holland at McGill University for his contribution to our knowledge of sea ice distribution and circulation in the Arctic Ocean.

Le prix pour un étudiant gradué en océanographie fut décerné au Dr. David M. Holland de l'Université McGill pour sa contribution à la connaissance de la distribution de la circulation des glaces dans l'océan Arctique.

Rube Horstein Prize in Operational Meteorology: Awarded to Michael Purves of the Yukon Weather Centre for his continuing efforts in developing new operational forecast techniques.

Le prix Rube Horstein en météorologie opérationnelle fut décerné à Michel Purves du Centre météorologique du Yukon pour ses efforts constants dans le développement de nouvelles techniques opérationnelles de prévision.

Reviewer of the Year in Meteorology: Award to Dr. Peter Schuepp for excellence in reviewing meteorology papers for the editors of Atmospheric-Ocean.

Le critique de l'année va à Peter Schuepp pour son excellent travail de révision d'articles météorologiques pour les éditeurs de « Atmosphère-Océan ».

Federal S&T Policy Review

The Honourable Jon M. Gerrard

Speaking Notes of the presentation at the
28th CMOS Annual Congress
May 31, 1994

It seems redundant to remind this audience that the world economic order has changed, and that science and technology are playing an increasingly important role in this new world order. I am doing it anyway however, to highlight the fact that as the importance of science and technology has increased, so too has the importance of being able to manage our S&T resources effectively in support of national objectives.

This Government is committed to: (a) growth and jobs within the context of sustainable development; and (b) a knowledge-based economy, since the present economy is showing a declining ability to maintain the wealth-creating capacity of the country.

By a "knowledge-based economy", I mean one in which: growth is sustained through aggressive use of knowledge, to achieve more efficient methods of production, organization, and natural resource stewardship; technological change is the main driver of long-term economic growth, in large part due to developments in science; and comparative advantage depends increasingly on acquired knowledge and skills, not just natural advantages.

Moving Canada towards such a knowledge-based economy is not an easy task we are faced with many challenges: greater investments in R&D are needed, but alone will not make the necessary difference; economic performance depends on the way available resources are managed and organized, both at the level the firm, and at the national level; this gave rise to the Red Book view that what Canada requires is a "national system of innovation" a system of policies, programs and institutions in the public and private sectors that work well together to produce and distribute knowledge and information efficiently and effectively in response to the needs of Canadians; even if we get this system right, the behaviour of decision-makers out there has to change everyone has to come to recognize that innovation is an essential ingredient in a healthy economy, and act accordingly.

In the Budget Speech, Paul Martin, the Minister of Finance, stated that the Minister of Industry would be issuing a public discussion paper on science and technology, and leading a review of federal science and technology expenditures, as the basis for developing a national strategy on science and technology. This is a $7 billion question.

Specifically, Mr. Martin referred to a "true strategy for R&D, one with real priorities, real direction, and a real review of results". This challenge is not a new one. The first federal science policy machinery was set up in 1917. Since then, and especially in recent years, federal and provincial governments, separately and together, have tried to find out how to get more economic bang out of our S&T buck. Over the past thirty years, a dozen separate reports have made recommendations for changes to various aspects of science and technology planning and operations.

But, in 1994, the country still does not have a national science and technology strategy. What we need is a vision and a strategy which position science and technology as key assets in the Canadian economy to ensure its adaptability and sustinability from both an economic and an environmental perspective.

As you have probably heard, we are taking concrete action on our Budget commitment. A review of federal S&T is underway and we will be launching a public dialogue on S&T issues in June, aimed at defining a national vision and strategy for S&T.

This national strategy will integrate a wide range of issues, including S&T policy, education, human resources, and industrial participation. It will address how to align federal S&T expenditures and activities to national economic and social goals. It will also consider how priorities can be set based on estimates of the relative expected values of different potential investments in science and technology. This process will require broad participation by Canadians to achieve a national consensus that will be critical if we are to succeed.

The S&T community cannot afford to have S&T seen as a "special interest" pursuit. Nor, in the interests of national prosperity, can the country as a whole continue to view it as such. As a nation, we must embrace the concept of a national strategy for science, and technology on which to base our future economic agenda. We need to establish priorities to guide our future spending decisions in science and technology. These priorities should recognize which activities are essential, which are of high priority, and which are of lower priority. This will provide a rational basis for the future management of our important, but limited, S&T resources.

The S&T review process has three tracks: an internal review of federal S&T led by a Task Force at the ADM level; an external, public consultation process, based on a discussion paper to be released in June and a series of regional conferences in September; and expert challenge and review of the process by the National Advisory Board on Science and Technology (NABST).

The review process will be based on the following principles: transparency to Departments, Ministers, and the people of Canada; inclusiveness all departments and agencies will be involved in the process; decentralization key science departments and agencies will take on much of the analytical work -- this will not be an S&T review by "bean counters"; and collaborative decision-making among Ministers in Cabinet - the Minister of Industry will not be making the decisions unilaterally.

The review of federal S&T activities that is just getting underway is intended to provide a set of department/agency reports which will make transparent where, why, and with what priorities, government allocates its science and technology expenditures. The review will also examine the extent to which S&T expenditures for similar and related objectives, when considered together across departments and agencies, constitute coherent strategies to support federal economic and social objectives. As well, we will be identifying those new horizontal or cross-government policy issues that require the attention of Cabinet. The overall objective of the entire review exercise is to build a foundation for a national system of innovation which will create new jobs and sustainable economic and environmental wealth, preserve and enhance the quality of life for Canadians; and, advance Canadian science to create an innovative society. Sustainable development is an imperative that has an impact on each of these three objectives. Long-term wealth and job creation can only be achieved through the sustainable use of Canada's resources. Indicators of sustainability will need to be developed and monitoring systems set up to protect the quality of our ecosystems. Only long-term research will enable us to gain an understanding of how our ecosystems function.

By the end of 1994, I expect that the review process will have led to Cabinet agreement on a national vision for science and technology, and a strategy for the federal component of making the vision a reality. We should have a collective sense of how federal S&T expenditures and activities can be aligned to achieve the goals of future economic growth, job creation and the best possible quality of life for Canadians. This will be followed by invitations to Provincial governments, to extend this work to develop a national strategy.

The S&T review can make a significant contribution to sectoral and environmental policies by identifying and reducing overlaps across the country; identifying where spending on S&T can reduce overall non-S&T costs; and finding ways of achieving more synergy among government players.

The science and technology review should provide us with better tools for looking across the scope of government activities to minimize duplication of effort, build upon partnerships and encourage stronger mutually-supportive and truly national S&T activities. We have ambitiously set ourselves a short time frame in which to complete a major national undertaking. I am confident that we will succeed in our aims, indeed, we cannot afford to fail. I am, therefore, looking forward to hearing comments over the summer and fall, from Canadians interested in participating in this important strategy development process. - Thank you.

Sustainable Development: Pipedream or Survival Imperative

Maurice Strong
Chairman, Ontario Hydro

Speech to the Global Change Forum
Canadian Meteorological and Oceanographic Society
Government Conference Centre, Ottawa, Ontario
30 May 1994

I very much value this opportunity of joining you this morning in what is clearly a very timely and important forum. I have long had good reason to appreciate the work of the Canadian Meteorological and Oceanographic Society, and the other cosponsors of your program, and indeed have benefitted from it immensely in my own international life. I appreciate too the spirit of public responsibility which you all demonstrate in your sponsorship of this forum.

I was interested to read in the conference brochure that the other parts of the Congress this week provide a forum for your own members to discuss in more scientific depth the work being done in the trenches of oceanographic and meteorological sciences. This invoked for me a personnel recollection of almost two years ago when I spoke at the very end of the Earth Summit at Rio de Janeiro. I said at that time that what we must all do now is to move down from the summit into the trenches where the real world actions and decisions are taken that will, in the final analysis, determine whether the vision of Rio will be fulfilled and the agreements reached there implemented.

This forum makes it clear that we have in Canada not only an impressive cast of real world actors, but also a dedicated and influential array of back stage workers without whom no production can be successful. I'm pleased to be amongst you for, after the UN Conference on Environment and Development in Rio, I returned also to the mainstream of business life to practice what I had been preaching about sustainable development as Chairman of Ontario Hydro. A gentleman who led me in that direction is going to be speaking here later this day, Stephen Lewis. I sometimes feel thankful to him, and sometimes wonder. So, I too have made my transition back to the trenches.

I can think of no other disciplines whose fields of study and work are more significant to the inhabitants of this planet than meteorology and oceanography. Nearly three quarters of our earth, I need not remind you, is covered by the sea. The entire globe is enveloped in the atmosphere. One of the roles I have valued most highly in my international life was that I have had the privilege of speaking on behalf of that nameless, faceless and unrepresented three-quarters of our planet, the oceans, in negotiations on the Law of the Sea - I should say the ocean environment. We could not exist without the two elements which are the subject of your professional interest. It's therefore a particularly bitter irony that we humans have been so profligate in our uses and abuses of these truly vital resources.

Global change is an inevitable ongoing process. Change is one of the prime factors of our universe and the change certainly didn't begin with the advent of human life on earth. However, the difference today is that human beings are the primary agents of change. Changing at the margins. Significantly changing, with effects that we still cannot entirely be sure of, the natural processes that shape our future and on which human life depends. In a very real sense we are now in command of our own evolution. Destined, whether we like it or not, to manage the processes which will determine our future on this planet.

Just over two decades ago alarming evidence of global environmental degradation existed to persuade the United Nations to convene the Conference on the Human Environment in Stockholm in 1972. Even then we did not fully appreciate the dimensions of the human impacts on our natural environment. For example, concern over the ozone layer at that time was directed mainly towards the potential effects of supersonic aeroplanes. We were just beginning to get an inkling of the climate warming effects of CO2 emissions.

In spite of the international attention focussed on the world's environment by Stockholm, and significant progress in some areas, overall the environment of the planet continued to deteriorate in the twenty years between Stockholm and Rio. In that period the world's population grew to four and a half billion from 3.8 billion, an increase equal to the total population of our planet at the beginning of this century. What's more, nearly half those people now live in cities. Of the ten new megacities that emerged during the same two decades, nine of them were created in developing countries, accompanied by massive health and social problems. You'll be hearing more on this subject this afternoon from my good friend and inspiration Stephen Lewis.

The industrialized world also continued to despoil the environment. In 1972 there were 250 million motor vehicles in the world. In 1992 there were 600 million. Talk about a population explosion, the automobile explosion has been even greater in extent. These, along with fossil fuel burning plants in energy and other industries, were spewing 23 billion tonnes of CO2 into the atmosphere annually, up from 16 billion tonnes in 1972. To an impartial observer it must seem as though a homicidal homo sapiens species is bent on poisoning the very air that is our life-support system.

And what of the oceans. Two-thirds of the entire world's population live within sixty kilometres of a sea coast, and this is expected to rise to three-quarters early in the next century. Two-thirds of the world's cities with populations of two and a half million or more are beside an ocean or a tidal estuary. The oceans have become the great garbage dump of the earth's inhabitants and, of course, as Clifford Lincoln reminded us, are one of the principle recipients of the changes in climate that seem to be underway.

Fertilizers, pesticides, destructive land use practises, forest clearance, human waste, industrial pollution and offshore resource exploitation have combined to degrade the coastal environment and the sea itself in most parts of the world. In some areas such as the coral reefs off southeast Asia, the Philippines and Sri Lanka the damage is already irreparable and the ultimate consequences to ecosystems and biological diversities incalculable. But we don't need to look that far abroad for a sobering reminder that for all its vastness the oceans bounty is after all finite. In Atlantic Canada, groundfish stocks last year reached their lowest number in history. In response our government has essentially shut down the eastern cod fisheries and drastically cut quotas in other sectors. This has put some 50,000 fishers and processors out of work. The largest layoff I believe in Canadian history and just the beginning, unfortunately, of an ominous new wave of environmental victims whose jobs and livelihoods will be at risk in our resource industries if unsustainable development is allowed to continue.

Over one hundred years ago anyone who predicted the total depletion of global fish stocks would have been dismissed as a crackpot. Today this incredible scenario seems an all too real possibility. How could it have happened. In commercial fishing, as in many other aspects of our high tech industrial civilization, we have become remarkably efficient at exploitation, and notoriously negligent in the fine art of husbandry.

In describing our profligate use and abuse of earth's resources I often use a business analogy. We have been managing the business of Earth Incorporate in effect without a depreciation, amortization and maintenance account. The company has been making profits and paying dividends to be sure, but much of the benefits enjoyed by the privileged few of its shareholders out of this process has been produced, in fact, by a running down of the earth's capital. This reckless management style is no more sustainable for the earth than it is for any business. If Earth Incorporated were to continue on this path it would clearly be headed for bankruptcy. The disastrous plight of today's North Atlantic is a chilling witness to my metaphor.

It was only a matter of time. The only question was whether we would completely exhaust the marine stock, before we could poison it. Fortunately, we have recognized the threat before, hopefully, it is too late. And harsh as the current government actions are on those people directly involved there is at least a safety net to replace the fishing nets, to allow time for nature to heal the harm and replace the decimated biosystems of the plundered depths. It seems clear to me, and I, of course, am not a scientist as those of you who follow my remarks will obviously discern, that it doesn't need a scientist, surely, to say that we have in this crisis a test case for what must be a global transition to sustainable development. We have a situation in which the threats posed by our historical patterns of production and consumption have become not just predictable, but real and present. We have a recognition that fundamental change is required to reverse the ruinous exploitation of the past, and its consequences. We know that this change must entail social and cultural upheaval for many, but that, in a very real sense, it involves and is indeed critical to the future of us all. So here in Canada the

need for sustainable development has come out of the laboratory, out of the realm of theory and hypothesis, and into our very real and jarringly awakened here and now consciousness.

If the current situation in this part of the world merits the term disaster by our standards, then the situation in many developing countries portends unmitigated potential catastrophe for them. We have the means not only to cushion the financial blow for large numbers of people put out of work by a crisis of this sort, (and our means as we are constantly reminded are not unlimited either) but also we have the means to make up the shortfall in fish with other sources of protein food. In many developing countries neither form of relief is available.

A year ago King Carl Gustaf of Sweden hosted a colloquium on tropical and sub-tropical coastal zones in which I had the opportunity to participate. Now I am not a marine biologist, nor a scientist of any kind, but as I said earlier, you don't really need to be an expert to see some of the visible evidence of much of the data that will be presented here at this conference on a more technical level. For example, in Asia alone, approximately one million humans are exclusively, or almost exclusively, dependant on fish for the basic protein necessary to their health and life. They have no affordable or available alternative. Their dire condition is mirrored in many other developing countries. So you see that even in our crisis there is a desperate disparity between north and south and this is part of a much greater imbalance that threatens the future of our entire civilization. We simply cannot address our problems without the deep involvement and participation of the some seventy-five per cent of the people that live in the developing countries, and they can't do it either without our help.

This is part of a much greater imbalance which threatens our very future. The most obvious and ominous sign of this north-south imbalance is the contrast between the concentration of economic growth in the developed countries, and of population growth in the developing countries. In the twenty years between the Stockholm Conference and the Rio Earth Summit, world GDP increased to some twenty trillion dollars, but only fifteen per cent of the increase accrued to developing countries which at the same time accounted for most of the population growth. The abject and debilitating poverty in which many developing country people live creates day-to-day imperatives of survival that drive them to exploitive practices which destroy the resource base on which their future depends, and in the process, continues to effect a deterioration in the global environment.

Sub-Saharan Africa, one of the many regions that I have visited frequently, illustrates this tragic dilemma dramatically. Growing human and animal population escalate pressures on the land, resulting in destruction of trees, overgrazing and degradation of soil. These conditions are made worse by recurring droughts, intolerable national debt burdens, economic recession and destructive human conflicts. People deprived of their livelihoods are driven to eke out a marginal existence on new lands, often more fragile and vulnerable than the ones left behind, or in the festering slums of cities and towns. The result, more poverty and more pressure on an already vulnerable and diminishing resource base. It is clearly a vicious circle.

So the crisis of the fisheries here has its land-based counterparts, in fact there is no part of the natural environment unaffected by the unprecedented increases in human population and even greater increases in the scale and intensity of human activity which have occurred largely in this century. And although the majority of the world's people, those in the less developed countries, bear a disproportionate share, I submit, of the costs and the risks of this growth, no humans are unaffected by the threats that they pose.

It was against this background that the United Nations convened the Rio Earth Summit in June of 1992. Generating the basis for a radical shift in economic behaviour the world over was the principle objective of that gathering. It was clear that you cannot address our primary environmental concerns simply through environmental ministries and agencies. It really requires fundamental changes in our economic behaviour. That was the primary theme of Rio. I believe it succeeded to a degree in placing the urgent question of our planet's future under an enormous international microscope. It escalated the debate over the need for action to stop the degradation and depletion of earth's life sustaining assets. However, as of now it has not resulted in those fundamental changes of behaviour and shift of direction the need for which it pointed out. As a political event, I think it is not too much of an exaggeration to say that it was historic. Never before had so many of the world's leaders gathered to discuss, let alone agree on, such fundamental issues as those that effect the future of the planet that were the prime issues on the Rio agenda.

I am gratified and encouraged to note that the Rio agenda has also become the agenda of so many other groups around the world, scientists, educators, bankers, architects, labour organizations, women's and indigenous peoples associations, young people, not to mention meteorologists and oceanographers. This widespread grassroots follow-up to Rio is in no small part due to the influence of the parallel Rio conference, The Peoples Summit, at the Global Forum, which attracted unprecedented numbers of people representing a broad spectrum of non-governmental organizations, professional and citizen groups. This people pressure helped to move the 179 governments at Rio to agree on a declaration of principles, the Declaration of Rio, and a comprehensive program of action to give effect to these principles - Agenda 21. It is continued people pressure which is keeping the spirit of Rio alive while many governments, perhaps predictably, have turned their attention away from saving the world, or their own environments, to the more immediate and politically more pressing issues that face most of them. In spite of the burgeoning grassroots interest and enthusiasm it would be naive to pretend that there is still not a great deal of misunderstanding about these issues, and also a tremendous lack of knowledge about the global dimensions of the kind of challenge we face. The misunderstanding is great even in societies like Canada which contribute disproportionately to

these problems --- maybe our percentage contribution is small but the disproportion is great.

This lack of knowledge was certainly brought home to me recently by the media furore over Ontario Hydro even considering an emissions offset program involving Ontario Hydro's consideration of a possible purchase of rainforest lands in Costa Rica - as one possible means of offsetting its CO2 emissions. We are after all one of the largest, if not the largest, single source of CO2 emissions in Canada. We have the responsibility to do our part in fulfilling Canada's obligations under the climate change convention.

I am pleased that we were able to raise the level of public debate on these issues above the rather trite and superficial response that they initially invoked. The controversy excited by this very preliminary study is disconcerting in one sense in that it reveals the low level of knowledge and understanding that exists on the vital issue of climate change. But it also has a silver lining. The focus of attention on it certainly has helped to increase public awareness of the serious issues that are involved here and the need to get down to practical actions to deal with it. It was dismaying I'm sure to many of you to see the low quality of the debate in our legislature in Ontario on this subject when the issue arose. However, I like to think perhaps the quality of that debate will be elevated a bit at least by this incident. There's a little good that can come out of everything, no matter how temporarily irritating.

As societies around the world confront the limits of government, the role of non-governmental actors becomes increasingly important. The proliferation of grassroots activities will, I believe, infuse new energies into the political process, and ensure that the issues of Rio will move back onto the centre of the political agenda. But this will not happen automatically. We need accelerated efforts to expand awareness of the critical issues, and information on how to deal with them, particularly as to the ways in which individuals, communities and associations can take actions that will make a difference. This must be accompanied by the development of more effective channels and instruments through which people can articulate their concerns and give practical expression to their interests.

In my view the real hopes for the future rest on the degree to which people themselves respond to these challenges. To facilitate all of this the Earth Council was formed last year following more than a year of preparation and consultations with some ten thousand organizations and a broad cross-section of development, environment, social and public policy leaders and experts throughout the world. The Earth Council, of which I am privileged to be Chairman, will act as a catalyst to facilitate implementation and follow-up of the Earth Summit agreement, by working with other organizations to ensure that public dialogue on the issues is illuminated by the objective knowledge and opinions of scientists and experts, and that the concerns, interests and experience at the grassroots level are brought to bear at all levels of policy and decision making. As some of you in this audience will know, one of the sponsors of the Earth Council was in fact the International Council of Scientific Unions. In the final analysis we will need dedicated people at all levels, including government, business and the scientific community.

Let me finally mention some of the important implications of these issues for science and scientists. The vast improvements in the human condition which accompanied the industrial revolution, as well as a new generation of risks and problems which have accompanied them, have been largely driven by advances in science and their application through technology. Science and technology also provides us with the insights and the tools on which we must largely rely to deal with these issues. Science has taught us that environment and development issues are global in scale and systemic in nature, and if we are to remain within safe limits we must manage the changes that are shaping our future. To do this we must surely adopt an integrated systems approach --- this is axiomatic to you people, clearly. The Earth Summit tried to provide the basis for this --- primitive, obviously inadequate, but still the best we have --- in Agenda 21. In this we have some very valuable help from the scientific community, principally again through the International Council of Scientific Unions which served as our scientific advisors.

The UNCED experience underscored the need for a better balance between the increasing degree of specialization within the scientific community and the need for more interdisciplinary integrated capabilities, both within science and between it and the economic, social and public policy communities. Canada is especially well served in this respect, thanks mainly to the organizations represented in this Global Change Forum. Canada has made, both at the scientific and at the policy levels, contributions to the international process of dealing with global environmental issues that have been valuable and influential far out of proportion to our size as a nation.

It seems to me one very very good example of this is our meteorological service, which has demonstrated impressively the contributions that national weather services can make and are making to sustainable development --- an asset not always fully appreciated by Canadians.

I've noted with concern that despite the growing international dimensions of virtually all the activities that bear on sustainable development there is a significant degree of protectionism amongst some of the important actors in respect to these issues, particularly on the part of the governments and corporations that finance research. This tendency is undoubtedly due, at least in part, to the increasing degree to which knowledge and technology are regarded as sources of competitive advantage. Indeed at the very time when the world is moving toward freer trade in goods and services, the commercialization of basic research, and the accompanying attempts to transform knowledge into intellectual property, are threatening to impose new barriers to the free flow of knowledge which has become one of the most important features of science.

In a world in which the knowledge generated by science is the primary driver of societal change, scientists have a primary role. But it is one they share, or course, with leaders and

practitioners of politics, economics, social affairs, culture, education and religion to name but a few. The task of moving the human community toward a more secure, sustainable and equitable future is a challenge which must unite us as ever before. I believe there is real basis for hope that the Earth Summit did in fact lay the foundations for changes in public attitudes and the political mindset necessary to achieve the transition to sustainable development.

I believe that, as my friend Norman Myers at Green College in Oxford said, scientists and technicians and others involved have to become as familiar with the corridors of political power as they are with the ecosystems on which they are working professionally. And I believe that is happening. I'm firmly convinced that today, some two years after Rio things are happening, frankly not yet on the scale or to the extent necessary, but things on which we can build. They are still far away from the change of course that Rio called for, but there are some unmistakable signs of leadership and initiative that will help to provide the basis for the veritable ecorevolution that is required to make the transition to a sustainable future. This new change of course will be driven by the full integration of environmental concerns into our economic life and behaviour. It will involve the reshaping of our entire industrial system, in which efficiency in the use of materials and energy and in recycling and disposing of waste will be the key to success in both environmental and economic terms. And this requires a real full cost accounting that brings into our cost and pricing systems the full environmental and social costs of the products and services we use. It's an immense job, but it can be done, if only because there is now an almost universal recognition that it must be done.

Or, our civilization could well proceed as the doomsdayers have prognosticated by degenerating into chaos, conflict and continued environmental degradation. It would be as wrong to deride the scenario of the doomsdayers as it would be to consider it inevitable.

Half a century ago at the height of another global struggle, the American William Thomas Cummings said "there are no atheists in the foxholes". By the same token, I would say that there can be no pessimists in the post-Rio environmental trenches, for pessimism would be self-fulfilling. As long as there is the slightest chance that we can make the transition to a more secure and sustainable way of life on our planet we must continue to strive for it, and I am delighted and encouraged to have the opportunity this morning of participating in the opening of this conference with so many of those who share our convictions and who are meeting their responsibilities with the kind of skills and professional experience that this cause so badly needs. - Thank you.

New CMOS Members / Nouveaux membres

Voici la liste des nouveaux membres, approuvés à la réunion de l'exécutif du 20 avril:

Nathalie Barette	Montréal QC	éudiante
Stephen Beagley	North York ON	régulier
Cathryn Bjerkelund	Ottawa ON	régulière
Michael Danilyn	North York ON	régulier
Philippe Gachon	Montréal QC	étudiant
Laurence G. Lee	Louisville Kentucky	régulier
Jasmine Paola	Richmond Hill ON	régulière
Thomas Rahme	West Vancouver BC	étudiant
Appolo Tang (Teck Choon)	North York ON	étudiant

Approuvés à la réunion du Conseil du 31 mai 1994

Denis D'Amours	Mont-Joli QC	régulier
Maryse Beaudremin	Montréal QC	éudiante
Sébastien Biner	Montréal QC	étudiant
Byron Boville	Boulder CO	régulier
Eric Che'nard	Montréal QC	étudiant
Norman Gagnon	Montréal QC	étudiant
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David Ingstrup	Edmonton Alberta	régulier
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Marie-France Turcotte	Montréal QC	éudiante
Eva Mekis	Toronto ON	régulière
Serge Nadon	Hull QC	étudiant
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As set out in the document, "CMOS Guidelines for Accreditation", the criteria are:

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(2) The applicant must possess at least one of the following types of specialised training:

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   (ii) post-graduate degree from a recognised university in the natural or applied sciences or mathematics specializing in one or more branches of meteorology or oceanography; or

   (iii) three years of on-the-job meteorological or oceanographic experience.

3) Upon completion of the above educational and training requirements, the applicant must have spent at least two years of satisfactory performance at the working level in the field of specialisation included in this document. This should include at least some consulting experience.

Les entrées sur les pages suivantes sont réservées aux experts-conseil accrédités de la SCMO. Le processus d'accréditation a débuté en décembre 1986. Une liste complète des experts-conseil accrédités de la SCMO peut être obtenue du bureau d'affaires. Les personnes désirant l'accréditation doivent entrer en contact avec la Société à Ottawa afin de recevoir une copie de règlements et un formulaire d'application.

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