Symposium – A History of Meteorological Challenges

The elegant new auditorium of the Atmospheric Environment Service (AES) was put into full use during the centennial celebrations of the Canadian Meteorological Service at Toronto (reported above). Internationally renowned scientists reviewed their own disciplines covering the whole range of meteorology within the program (except for two changes) as published in *Atmosphere* (**9**, p. 67).

The concept of the symposium was to emphasize meteorological challenges met, attacked and to a degree overcome, but in such a way that challenges for the future would be clearly outlined. Thus the accounts would show a living history rather than just a record of a series of events. Overall, each speaker in his own characteristic style tried to fulfil this objective. Even though the ideal may not have been reached in every presentation, the papers were intrinsically interesting on their own merits.

Dr. B.J. Mason in action.

Several speakers were united in pointing out that many of the challenges in meteorology resulted from the need to provide services (aviation forecasting, pollution potential forecasting) or to prevent future disasters (hurricanes, storms on the Great Lakes, etc.). Others reiterated at length the continuing need to make many more measurements and to collect more data in order to verify theoretical models and to monitor environmental quality.

An excellent summary of the symposium sessions has been published elsewhere* and the reader is referred to this article. The highlights reported below are intended as a résumé of the challenges to be met by meteorology in the future.

Dr. P.D. McTaggart-Cowan, Executive Director of the Science Council of Canada, maintained that the challenges of the Seventies are here now, and the chief of these is concern with the environment. There is a need for predictive climatology using computer models. Meteorology must fully cooperate with agencies dealing with renewable or non-renewable resources as well as biometeorology. Universities must be given more resources to help expand their efforts in environmental studies.

In his discussion about the General Circulation of the Atmosphere, Dr. J. Smagorinsky (NOAA) reminded those in attendance that computer models of the atmosphere were not new, only their operational use for practical forecasting. Even though many refinements are being made in these models to include

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ocean-atmosphere and hydrological interactions at continental surfaces, albedo variations, etc., they still cannot explain the impact of the last 100 years of man's industrial activities. For further progress it has become imperative to be able to predict man's effect on the atmosphere.

More measurements of radiation in the atmosphere are required according to Prof. F. Möller (University of Munich): dust absorbs a large amount of the incoming radiation; cloudy skies are of special interest since they are so complex; the radiation balance of the atmosphere must be studied in detail.

A five-star performance was given by Dr. B.J. Mason, Director-General of the British Meteorological Office. He reviewed thoroughly the entire field of the Physics of Cloud and Precipitation. To advance this field of study even more, it is essential that two independent research groups should be brought together: scientists engaged in microphysical laboratory studies and meteorologists involved with the dynamics, sizes and shapes of clouds. He also noted that controversial theories and techniques have helped to stimulate scientific thinking (e.g., meteoritic dust theory and weather modification).

According to Dr. R.J. Murgatroyd (British Meteorological Office), Upper Atmosphere Meteorology can only develop if measurements are made as high as possible. However, balloon measurements must be standardized. Satellites yield better values (than rockets) for cold and warm thicknesses. Atmospheric constituents (even minor ones) should be measured in greater detail for air pollution studies, and to investigate ozone layer destruction. Radar networks must also be expanded.

Professor B.J. Bolin (University of Stockholm) discussed Atmospheric Chemistry and Environmental Pollution. At present the turbulent diffusion of pollution is not considered to be a major problem. Meteorologists must become involved with biometeorology and chemistry to learn how man affects the cycles of natural atmospheric constituents. The carbon cycle must be studied in detail (CO_2 increases 4%/annum from industrial activity). Residence time of SO_2 must be determined since it can move 1500 miles in 2½ days and cross international boundaries. N_2 cycle is not well known. Meteorological research is essential in the study of air pollution which is also a problem in other areas of scientific research: because meteorologists have experience with computer modelling; atmospheric transport is a crucial link; and some constituents result from meteorological processes.

Dr. R.W. Stewart (Canadian Water Management Service, Vancouver) categorically stated that there was only one challenge in the field of the Atmospheric Boundary Layer – to parameterize turbulence. Even though turbulence theory has developed from the Reynolds stresses through Lagrangian processes and correlations and Richardson Numbers to modern similarity theory, there was a real need to direct theory and observation to parameterize models correctly (especially with the help of computers). The results will be used to provide service to scientists who must solve air pollution problems.

Professor V. Suomi (University of Wisconsin) gave a graphic example of how technological advances in other fields helps meteorology. The GHOST system,

which employs better balloons to allow practical soundings of the stratosphere to be carried out, got Dr. J.G. Charney interested in GARP and as a result theoretically-oriented scientists were brought into mutual cooperation. The age of the satellite is revolutionizing the whole system of data acquisition.

Even natural disasters have helped to foster development in Dynamic Weather Prediction according to Dr. G.P. Cressman, Director, National Weather Service (NOAA). Storms in 1950 and 1953 were missed by forecasters but caught by early computer models. As more physics has been input into the forecast models the predictions have advanced significantly. By 1980 the practical limit of predictability should be reached; however, a short-range forecast of 6 hours will require a resolution of 25 km and a computer power 200 times that of current CDC machines. He gave an encouraging note to forecasters since he could envision that they would still be needed over the next 100 years (at least) to weigh the ensemble of forecast products for short-range forecasts.

Dr. J. Clodman (AES, Toronto) listed a whole host of mesoscale problems that need to be attacked to solve practical environmental problems, including: land/sea breeze, lake effect storms, mountain valley winds, squall lines, tornadoes and CAT. However, NWP techniques are very difficult to apply to numerical prediction of mesoscale effects except for terrain-induced phenomena where pre-existing mesoscale fields are not important. If interactions with the terrain can be understood then a lot of these phenomena can be reasonably well predicted.

In the domain of Applied Meteorology and Environmental Utilization, Dr. R.E. Munn (AES, Toronto), stressed that interfacing with the consumer is absolutely essential in the modern world. The information explosion has forced all scientists to engage in interdisciplinary dialogue which can be achieved by interdisciplinary symposia, reviews and institutes, for example. Ironically consultants must become specialists since user needs are changing rapidly with time. In biometeorology more studies of human stress must be made; urban monitoring networks must be expanded. Decision makers, managers and planners should routinely use cost/benefit analyses with the appropriate weather input parameters.

Dr. R.E. Hallgren (NOAA) spoke in place of Dr. Robert M. White on the Winds of Change. He pointed out that the human race usually meets challenges which are caused by crises of their own making. It is becoming important to organize in order to meet new challenges arising in the environment. The atmospheric sciences must be concerned with the total environment but this necessitates integration and cooperation if the goals of environmental management are to be achieved. For effective integration, service activities must be coordinated in the highest type of organization (e.g., NOAA in a new Dept. of Natural Resources). Linkages must be formed between agencies and competent interested persons. Research cannot be carried out under only one umbrella but interactions must be on a lateral basis especially since only specialists should be employed to solve particular problems.

The final impression resulting upon the sessions was that the symposium was

an outstanding success. The participants after three days of active dialogue were grateful and exhilarated. The organizers of the symposium did a superb job – unfortunately this seems only to occur once in a blue moon (or at least only once each century).

Of course all that could be said was not delivered by each speaker in the allotted time. The Proceedings of the symposium are therefore awaited with increasing interest and are expected to be published during the summer of 1972.