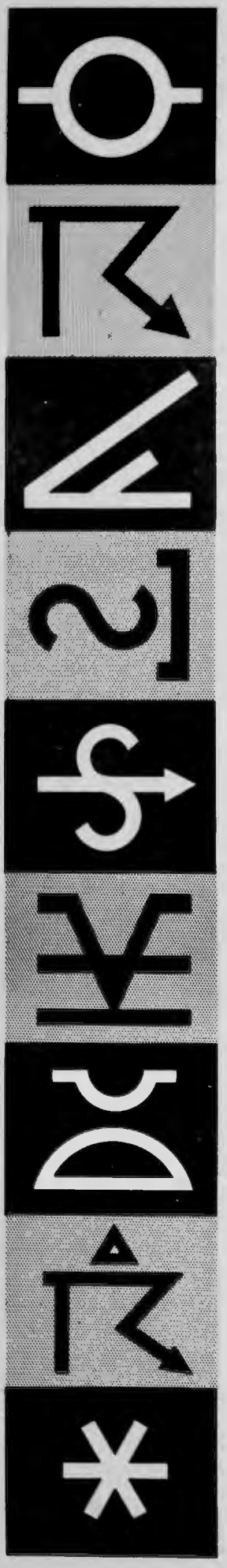

ZEPHYR

SEPTEMBER 1975 SEPTEMBRE

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NORWICH SYMPOSIUM ON LONG-TERM CLIMATIC FLUCTUATIONS

by M.K. Thomas

A five-day Symposium on Long-Term Climatic Fluctuations was held August 17-23, 1975, at the University of East Anglia in Norwich, England. Sponsored by the World Meteorological Organization and the International Association of Meteorology and Atmospheric Physics, the Symposium was organized by Professor H.H. Lamb UEA's Climatic Research Unit.

The purpose of the symposium was to review (a) current knowledge of past climates and methods of their study; (b) patterns and statistical properties of climatic change; (c) theories of climatic change; (d) progress in numerical modeling of climate and climatic change, and (e) the predictability of climatic change. Approximately 65 invited and volunteered papers were presented and discussion was sparked through the use of panels and open discussion periods.

About 200 individuals attended the Symposium – meteorologists and climatologists, oceanographers and marine scientists, geologists and geophysicists, glaciologists and geomorphologists, biologists, statisticians and computer experts, environmentalists and engineers, agriculturalists and archeologists, educators, editors, writers and journalists. The participants came from all parts of the world; some 30 or more countries were represented. Most of the internationally recognized experts in climatic change – Bryson, Donn, Fletcher, Flohn, Fritts, Lamb, Lorenz, Manley, Mitchell, Schneider, Yamamoto, etc., participated in the Symposium. In the paragraphs that follow an attempt has been made to summarize the content of, and the impressions arising from, the different subject sectors of the Symposium.

(a) Paleoclimate

Through the study of deep sea cores, pollen, tree rings and volcanic ash, considerable paleoclimatic research is now underway in many institutions and government services around the world. Probably more satisfactory progress has been made in this sector of climatic change studies than in any other during the past decade. The United States CLIMAP program, where more than 100 people have been involved for three years, appears to be making the most progress. Paleoclimatological studies are of great academic interest to most people involved in climatic change studies and the resulting information on ancient climates will be most useful in testing the various mathematical models of climate and climatic change which are now under development.

(b) Patterns and Statistical Properties

Although much new material was presented, papers in this sector did not reveal any outstanding advances or breakthroughs in recent years. Spectral analysis methods, techniques and interpretations are being developed by various individuals and the complexity of the entire area is being revealed. However, spectral analysis of climatic fluctuation data over the past 10,000 years fails to reveal any statistical periodicity, except perhaps the quasi biennial cycle. Other papers dealt with specific geographical areas revealing, for example, that the recession of glaciers in East Africa cannot be correlated with temperature and precipitation data; that cyclonic activity in the Atlantic increased for six decades and then diminished prior to 1970; that a relatively small lowering of temperature in Scotland over

forty years could lead to glaciation; that climatic variations in the North Atlantic and North Pacific are synchronous, and that there is connection between regional synoptic controls and secular changes in precipitation.

(c) Theories

This sector of the symposium dealt with the various possible theories and causes of climatic change. In one paper it was suggested that the amount of carbon dioxide in the atmosphere coming from volcanoes amounts to less than 1% of that provided by the combusion of fossil fuels. Another warned that the effect of man-made aerosols must be most important since, in the Northern Hemisphere, there are three times as many aerosols present in the atmosphere over the land than in that over the sea. Much progress has been made in recent years in the atmospheric physics of relationships between climate and changes in insolation, volcanism, changes in the quantity of aerosols in the atmosphere and ocean circulations. The important question of which is cause and which is effect still remains in ocean-atmosphere connections, while scientists are as yet uncertain as to whether there is a solar constant or a solar "inconstant".

(d) Numerical Modeling

In numerical weather prediction most processes can be described and modeled in their general physical terms, but in comparison, the numerical modeling of climatic change must deal with many terms that are almost completely unknown – the relationship of the atmosphere to the ocean, to ice masses, to the character of land surfaces, and to biomass – in other words, we are far from understanding the complete climatic system. The importance of water in its various forms, the necessity of considering global rather than regional aspects, and the general "resourcefulness" of the climatic system, are all of utmost importance.

In atmospheric and oceanic general circulation models, attempts are made to straightforwardly integrate the basic dynamical equations – that is, to resolve explicitly the large scale transient disturbances. In the statistical/dynamical models, attempts are made to parameterize the effects of large scale fluctuations – that is, to deal with longer time periods, and to neglect processes. There are problems galore, and during this sector of the symposium, an air of pessimism seemed to prevail. When one considers that climatic modeling, defined as "the development of a set of dynamical relationships governing the structure and behaviour of the global climatic system", has been attempted for only a decade or so, and that attempts must be made to incorporate the basic dynamic equations (conservation of momentum, mass and water vapour, equation of state, thermodynamic energy, hydrostatic balance, etc.), it is perhaps unreasonable to expect that much progress should have been made. Major problems have to do with model resolution, the parameterization of data, ocean-atmosphere coupling, how to treat the earth's surface and the need for better cloud data. Several scientists stated that it will be necessary to isolate the major factors first to reach a much better basic understanding of the processes than now exist before too much attention is given to "tuning" the models. Several felt that research will go faster with increased competition as a growing number of scientists and institutions are involved in numerical modeling. Several scientists cautioned against testing models with statistics rather than against physical events, while another raised an interesting question – How will we know when a predictive model really works?

(e) Predictability

It was generally accepted that there is as yet no promise of a sound scientific method of predicting climate. There was, however, a great divergence of opinion about what

individual scientists and national services might do over the years and possibly decades before scientific modeling can be achieved. One meteorologist expressed great concern that scientists might mislead the public, urged great caution, and suggested that predictions of climatic change should be better than tomorrow's forecasts before release to the public. On the other hand, another urged that scientists are obliged to tell what they know about climatic change in the precise terms, i.e., how much, how long, etc., and that the public should be told *everything* we know. This sentiment was echoed by others who urged that statistical data should be used to an increasing extent to warn the public of existing and possible future climatic change, and suggested the use of periodicities along with current climatic change information. Other speakers urged that climatic outlooks be made available to the public, along with definite expressions of certainty or uncertainty, and stressed the impact of climatic change predictions on the public. It was agreed that perhaps the period from one month to ten years ahead was most important for economic and public use, but unfortunately few, if any, institutions or national services were attempting general climatic outlooks for any more than one to three months ahead.

Summary

There was no sensational announcements or disclosures at the symposium. No one provided the definitive explanation of why climates change and no one offered a definite forecast for 1976. But evidence was provided that our knowledge of past climates is improving at an ever increasing rate as more resources are being made available and improved methods are being developed to study paleoclimates. Numerical modeling of climate is proving to be exceedingly complex, perhaps more complex than anything yet attempted by meteorologists, and undoubtedly more difficult than many had hoped for a decade ago. Progress is being made in mathematical modeling, although no one could promise a sound scientific method of modeling climate and thus of forecasting climate. Organized as a scientific symposium, there was perhaps too little time taken in debating what services could and should be provided to the public during the interim before predictive modeling becomes effective. Most people in attendance at the symposium, however, seemed to agree that since there is as yet no sound scientific method of predicting climate increasing amounts of statistical data must be provided and that significant efforts should be made to interpret this information to the public.

COLLOQUE DE NORWICH SUR LES FLUCTUATIONS CLIMATIQUES À LONG TERME

par M.K. Thomas

Un Colloque de cinq jours sur les fluctuations climatiques à long terme a eu lieu du 17 au 23 août 1975 à l'Université d'East Anglia à Norwich (Royaume-Uni). Placé sous les auspices de l'Organisation météorologique mondiale et de l'Association internationale de météorologie et de physique de l'atmosphère, ce Colloque a été organisé par M. H.H. Lamb du Service de recherche climatique de l'UEA.

Le but de ce Colloque était d'analyser les points suivants: (a) l'état actuel des connaissances sur les paléoclimats et les méthodes employées pour étudier ces climats; (b) les structures et les propriétés statistiques du changement climatique; (c) les théories du

changement climatique; (d) les progrès accomplis dans le domaine des modèles numériques du climat et de son changement et, (e) les possibilités de prévision des changements climatiques. Il y a eu environ 65 communications présentées sur invitation ou de façon spontanée et d'intéressants débats organisés sous forme de tables rondes et de discussions générales.

Environ 200 personnes ont assisté au Colloque, météorologistes et climatologistes, océanographes et spécialistes des sciences de la mer, géologues et géophysiciens, glaciologues et géomorphologistes, biologistes, statisticiens et informaticiens, environnementalistes et ingénieurs, agronomes et archéologues, éducateurs, rédacteurs et journalistes. Les participants venaient du monde entier: plus de 30 pays étaient représentés. La plupart des experts de renommée internationale dans le domaine du changement climatique, ont participé au Colloque, notamment: MM. Bryson, Donn, Fletcher, Flohn, Fritts, Lamb, Lorenz, Manley, Mitchell, Schneider, Yamamoto. On trouvera ci-après un résume des différents sujets abordés au cours du Colloque et des impressions qui en découlent.

(a) **Paléoclimats**

Dans le monde entier, de nombreux organismes et services publics ont entrepris d'importantes recherches paléoclimatiques en analysant des carottes extraites des fonds marins, du pollen, les anneaux de croissance des arbres et des cendres volcaniques. C'est sans doute dans le domaine des études du changement climatique que les plus grands progrès ont été accomplis au cours de la dernière décennie. Le programme CLIMAP des États-Unis, qui mobilise plus de 100 personnes depuis trois années, semble progresser plus que tout autre. Les études paléoclimatologiques intéressent énormément la plupart des personnes qui s'occupent de changement climatique et les renseignements qu'on peut en tirer sur les paléoclimats seront précieux pour vérifier les divers modèles mathématiques du climat et de son changement actuellement en cours de développement.

(b) **Structures et propriétés statistiques**

Tout en apportant de nouvelles contributions, les communications présentées dans ce domaine n'ont révélé ni progrès extraordinaire, ni percée spectaculaire au cours des récentes années. Plusieurs participants ont présenté des méthodes et des techniques d'analyse spectrale, ont proposé des interprétations et ont ainsi révélé la complexité de ce domaine. L'analyse spectrale des données sur les fluctuations climatiques des 10 000 dernières années ne révèle cependant aucune périodicité statistique si ce n'est peut-être le cycle quasi biennal. Dans d'autres exposés on a traité de zones géographiques bien déterminées révélant par exemple, qu'il n'est pas possible d'associer le recul des glaciers en Afrique de l'Est aux données relatives à la température et aux précipitations; que l'activité cyclonique dans l'Atlantique a augmenté pendant six décennies puis a diminué avant 1970; qu'un abaissement relativement faible de la température en Ecosse pendant quarante ans pourrait déclencher une glaciation; que les variations climatiques dans l'Atlantique Nord et dans le Pacifique Nord sont synchrones et qu'il y a un rapport entre les contrôles synoptiques régionaux et les changements séculaires de la précipitation.

(c) **Théories**

Au cours de cette partie du Colloque, il a été question des diverses théories et causes de changement climatique qu'il est possible d'envisager. On a suggéré dans une communication que la quantité de gaz carbonique de l'atmosphère en provenance des volcans représente moins de 1% de la quantité de ce gaz due à la combustion des hydrocarbures. Au cours d'un autre exposé, nous avons été prévenus que les effets des aérosols d'origine artificielle risquent d'être très importants puisqu'il y a trois fois plus d'aérosols

dans l'atmosphère au-dessus des terres que dans l'atmosphère au-dessus des mers dans l'hémisphère Nord. Il y a eu de grands progrès ces dernières années dans le domaine de la physique atmosphérique des relations entre le climat et les modifications de l'insolation, du volcanisme, de la quantité d'aérosols présents dans l'atmosphère et des circulations océaniques. Dans le domaine des relations océans-atmosphère on se demande toujours encore quelle est la cause et quel est l'effet car les chercheurs ne sont pas certains s'il faut parler d'une constante solaire ou d'une variable solaire.

(d) Modèle numérique

Pour la prévision météorologique numérique on peut décrire et représenter la plupart des processus par leurs termes physiques généraux, mais dans le cas de la représentation du changement climatique par un modèle numérique, il faut tenir compte de nombreux termes presque entièrement inconnus: la relation entre l'atmosphère et les océans, les masses glacières, les caractéristiques des surfaces terrestres et les biomasses, en d'autres termes, il y a encore beaucoup de chemin à parcourir pour comprendre le système climatique dans son ensemble. L'eau à ses divers états, la nécessité de tenir compte d'aspects globaux et non pas régionaux et les nombreuses possibilités du système climatique constituent également des facteurs de toute première importance.

Dans les modèles de la circulation générale atmosphérique ou océanique on essaie d'intégrer directement les équations dynamiques fondamentales, c'est-à-dire de résoudre explicitement les perturbations qui se déplacent à grande échelle. Dans les modèles statistiques dynamiques on essaie de paramétrer les effects des fluctuations à grande échelle, c'est-à-dire de tenir compte de longues périodes et de négliger les processus. On se heurte là à une foule de problèmes et le pessimisme semblait général pendant cette partie du Colloque. Cependant, si l'on considère que l'étude de modèles climatiques qui, par définition, constituent un ensemble de relations dynamiques régissant la structure et le comportement du système climatique global, ne remonte qu'à une dizaine d'années et qu'il faut essayer d'y incorporer des équations dynamiques fondamentales (conservation du mouvement, de la masse et de la vapeur d'eau, équation d'état, énergie thermodynamique, équilibre hydrostatique, etc.), il est peut-être présomptueux de s'attendre à de grands progrès. Ce sont la résolution des modèles, le paramétrage des données, le couplage océans-atmosphère, la manière de traiter la surface de la terre et le manque de bonnes données sur les nuages qui constituent les principaux problèmes. Plusieurs chercheurs ont affirmé qu'il faut d'abord isoler les principaux facteurs pour avoir une meilleure compréhension des processus avant de se consacrer à une "fine mise au point" des modèles. Certains pensent que les progrès seront plus rapides lorsque il y aura plus de compétition puisque de plus en plus de chercheurs et d'organismes étudient l'utilisation de modèles numériques. Plusieurs savants ont formulé des mises en garde contre la vérification des modèles par des statistiques au lieu de phénomènes physiques et en fin de compte un chercheur s'est demandé comment on fait pour savoir qu'un modèle de prévision du climat est au point.

(e) Possibilité de prévision

On admet généralement qu'il n'y a pas encore en perspective de bonne méthode scientifique de prévision du climat. Mais il y avait de grandes différences d'opinions concernant ce que les chercheurs à titre individuel et les services nationaux peuvent faire au cours des années et éventuellement des décennies qui nous séparent de la mise au point d'un modèle scientifique. D'après un météorologiste que le sujet préoccupe, les chercheurs risquent d'induire le public en erreur. Il a recommandé une extrême prudence et a demandé aux chercheurs de s'assurer que les prévisions de changement climatique sont meilleures que

les prévisions du lendemain avant de les diffuser au public. Un autre participant a, par ailleurs, affirmé que les chercheurs doivent faire part de leurs connaissances sur le changement climatique en termes précis, c'est-à-dire indiquer quelle en sera la durée, l'intensité, etc., et dévoiler au public *tout* ce que l'on sait. C'était également l'avis de ceux qui veulent qu'on se serve plus des données statistiques pour prévenir le public d'un changement climatique qui aurait lieu actuellement ou éventuellement à l'avenir et qui proposent d'utiliser les périodicités et les renseignements sur la modification climatique actuelle. D'autres conférenciers ont demandé que l'on communique au public les aperçus climatiques en indiquant clairement le degré de probabilité et ont insisté sur les répercussions des prévisions de changement climatique sur le public. On a convenu que les prévisions allant d'un mois à dix ans étaient peut-être plus importantes tant pour le public que du point de vue économique, mais malheureusement peu d'organismes ou de services nationaux essaient d'établir des aperçus climatiques généraux pour plus de trois mois.

Résumé

Aucune découverte sensationnelle n'a été annoncée au cours du Colloque, personne n'a donné d'explication définitive de la raison des changements climatiques et personne n'a proposé une prévision ferme pour 1976. Mais il est évident que notre connaissance des climats antérieurs progresse de plus en plus vite à mesure qu'il y a plus de ressources disponibles et qu'on améliore les méthodes pour l'étude des paléoclimats. L'utilisation de modèles numériques du climat s'avère extrêmement complexe, sans doute plus complexe que tout ce que les météorologistes ont entrepris jusqu'à présent et sans aucun doute plus difficile que ce qu'on avait pensé il y a dix ans. Il y a eu des progrès dans l'étude des modèles mathématiques, mais il n'y a pas en perspective de bonne méthode scientifique pour l'établissement d'un modèle du climat et par conséquent pour la prévision du climat. Comme il s'agissait d'un Colloque scientifique, on a peut-être consacré trop peu de temps à l'étude des services qu'il serait possible d'offrir au public en attendant la mise en service de modèles de prévision. La plupart des participants étaient cependant d'avis qu'il fallait obtenir beaucoup plus de données statistiques et que l'effort devait porter sur l'interprétation de ces renseignements pour le public puisqu'il n'existe pas encore de bonne méthode scientifique pour prévoir le climat.

THE SATELLITE DATA LABORATORY HIGH RESOLUTION PICTURE TRANSMISSION GROUND RECEIVING AND IMAGE REPRODUCTION SYSTEM

by C.I. Taggart

Since early in 1975, the Satellite Data Laboratory of the Meteorological Services Research Branch has been busy with the installation of equipment and in developing procedures to acquire and reproduce a new type of satellite data. This data is now transmitted direct by the High Resolution Picture Transmission (HRPT) service, the primary operational system of the Improved Tiros Operational Satellite (I-TOS) system of current NOAA U.S. weather spacecraft.

"S" Band antenna pedestal ready to be swung by crane into fibre glass dome on core #5 at AES HQ.
Le socle de l'antenne d'une longueur d'ondes de 1 697 Mhz est prêt à être monté par la grue dans le dôme en fibre de verre situé à l'angle nº 5 de l'administration centrale du SEA.

Pedestal and parabolic dish antenna awaiting mounting after the dome has been re-assembled.
Le dôme a été réassemblé: il ne reste plus qu'à monter le socle et l'antenne parabolique.

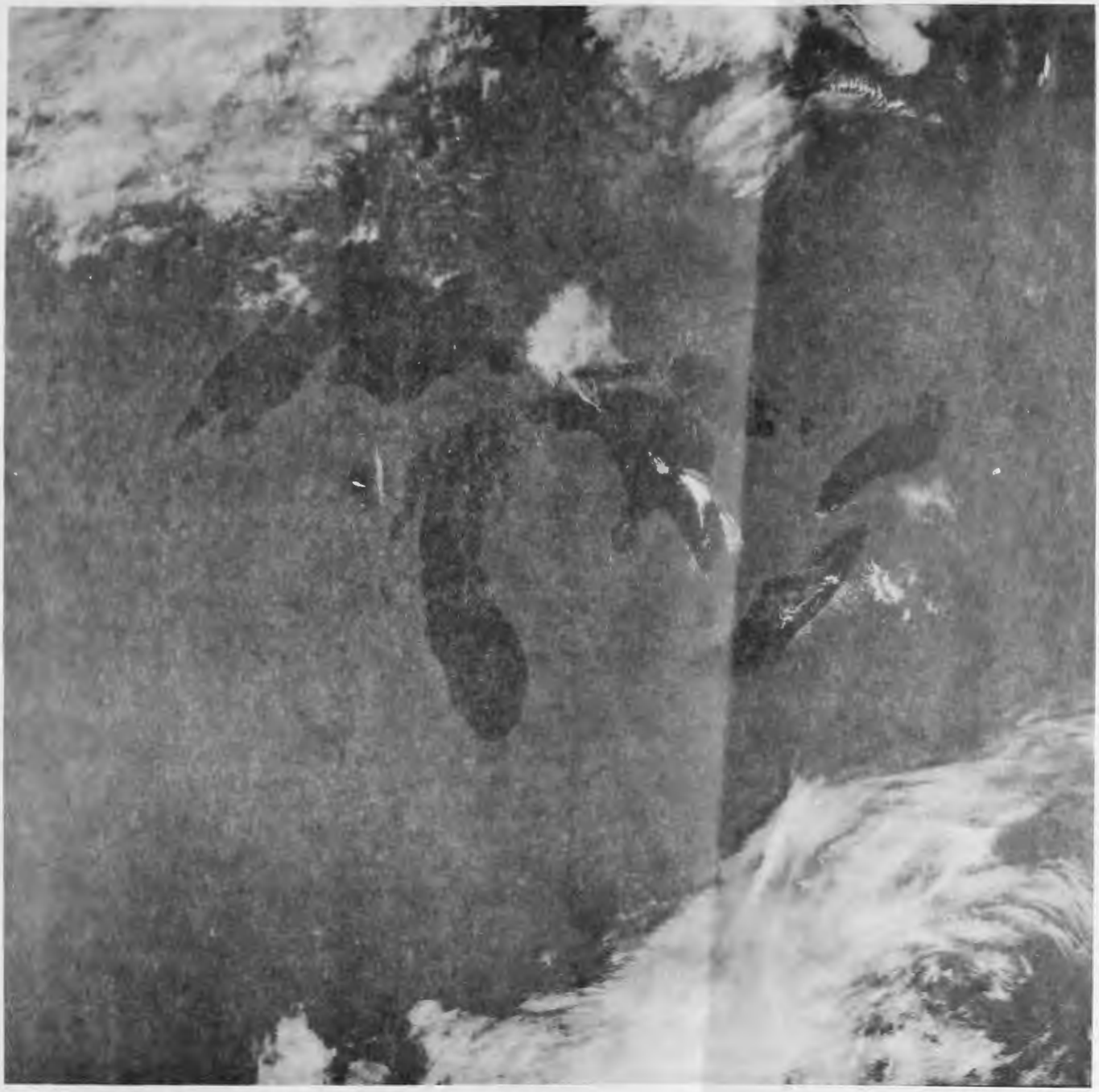
Control panel for VHRR in the SDL: showing interdata 7/16, M96 tape recorder and oscilloscope, receiver, antenna controller, discriminator, scan converter and synch detector from top to bottom in the right hand rack.
Panneau de commande du radiomètre à balayage à très grand pouvoir de résolution au laboratoire d'analyse des données recueillies par satellite: Interdata 7/16, magnétophone M 96, oscilloscope, et dans l'armoire de droite, de haut en bas: le récepteur, la commande de l'antenne, le discriminateur, le convertisseur de balayage et le détecteur à synchronisation.

The HRPT service provides Very High Resolution Radiometer (VHRR) imagery in both the Visual and Infrared spectrum with a resolution of 1/2 a nautical mile. VHRR visual and infrared data are transmitted simultaneously during the daylight portion of each orbit and infrared only during the night portion of the orbit to provide total high resolution world coverage on a 12-hour cycle. This system is much more advanced and hence more sophisticated than that of the initial APT system which gave only daytime imagery from a vidicon camera with a resolution of about 2.2 nautical miles. ESSA 8, the last spacecraft to carry the APT vidicon system, is now nearly time-expired, having been in operation for almost 7 years. It will not be replaced. APT type data is, however, provided by a Scanning Radiometer (SR) system with approximately the same resolution, and can be received by an APT type ground station.

The VHRR type data of the HRPT service requires a much more sophisticated ground receiving station because of the high data rates necessary to transmit the information to the ground and to reproduce it as a high quality, high resolution image.

As some AES people may have observed, during the early spring, a 10-foot diameter parabolic dish antenna was lifted by crane to the roof of the AES Headquarters and installed on a 2000-lb. pedestal centred in the fibre glass radome above Core No. 5 of the building.

This 10-foot "autotrack" parabolic antenna fits inside the dome so snugly that there is less than 1/2" of clearance between the insulation on the inside of the fibre glass



Computer-produced VHRR image of the Great Lakes area taken 7 Oct. 75. The outlines of Metro Toronto and Chicago can be discerned. A smoke plume from the Sudbury smelter and the Hamilton steel mills can be identified in the original print. Note the Mississippi, St. Lawrence, Ottawa rivers and other surface detail.

Photographie de la région des Grands Lacs obtenue par ordinateur et radiomètre à très haut pouvoir de résolution le 7 octobre 1975. On peut distinguer les contours des métros de Toronto et de Chicago. Un panache de fumée provenant de la raffinerie de Sudbury et de l'aciérie d'Hamilton apparaît sur la photo originale. Notez les détails tels le Mississipi, le St-Laurent, la rivière Ottawa.

Photos Courtesy of John Lewis
Les photos sont une gracieuseté de John Lewis

shell and the antenna feed. The feed sits on a tripod above the centre of the dish. In the feed, the radio signal reflected from the dish at "S-band" frequency (1697.5 MHz) is received on 4 small dipole antennas. The signal strength on each of the 4 dipoles is compared so that signal strength errors in both the X and Y directions cause the servo motors to drive the antenna in a direction to equalize the signal strength at each of the dipoles. This single channel mono-pulse autotrack system results in the antenna automatically moving to follow the satellite signal as the spacecraft crosses the reception area. The antenna is only required to be pointed to the point on the horizon where the satellite will appear, and when the satellite arrives it will automatically start up and follow until the satellite disappears below the horizon. Initial pointing of the antenna can be done by manual controls, or by command from a computer to point it to the right position for each successive satellite reception.

The received signal is fed from the antenna at roof location to the "S-band" telemetry receiver located in the Satellite Data Lab. The signal cable is a 7/8" coaxial cable inside an aluminum shield. It is in effect a semi-flexible pipe that cannot be kinked throughout its 225-ft. run down through the building to the Lab.

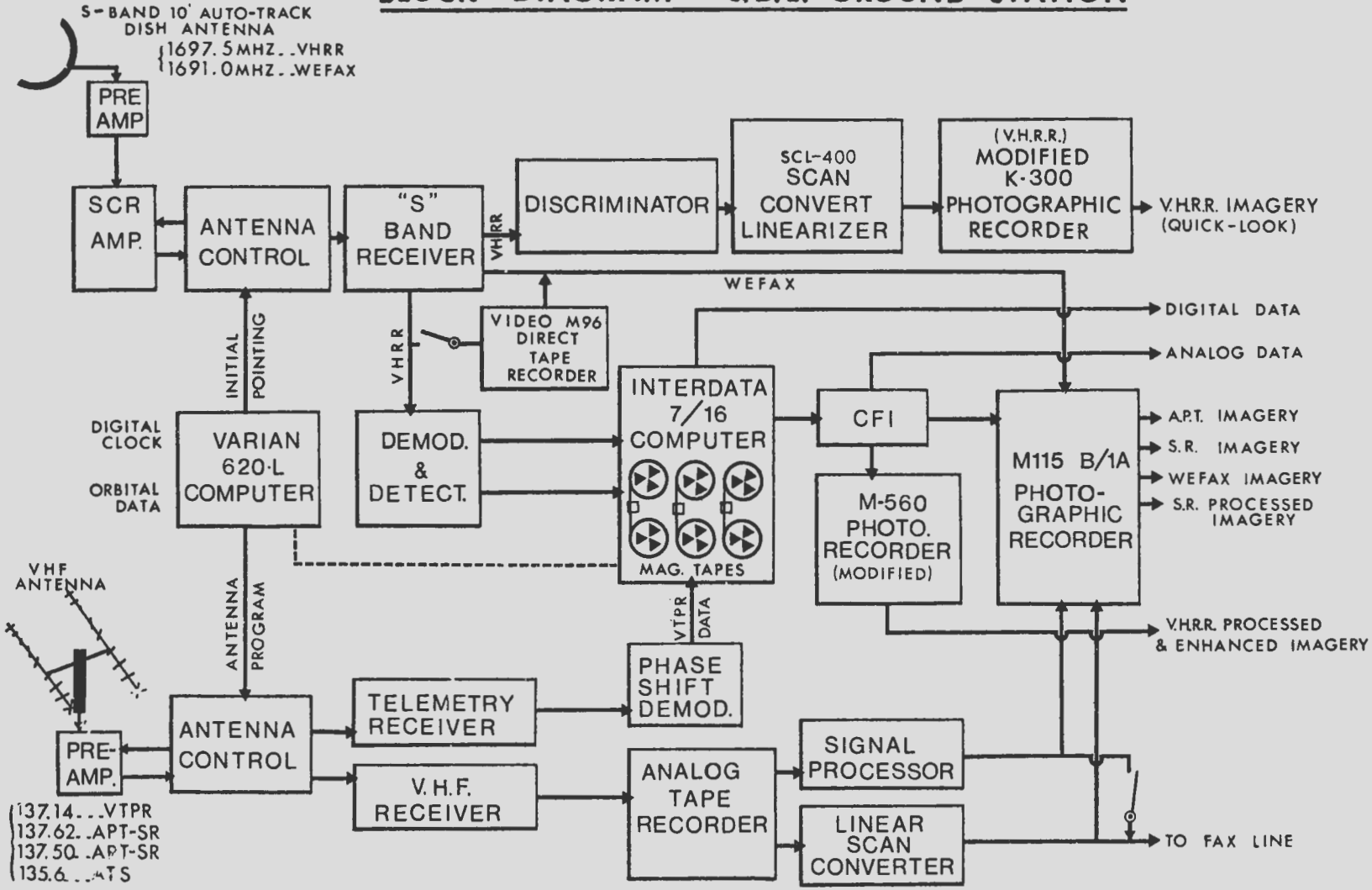
The VHRR signal is frequency modulated information on a frequency modulated sub-carrier so that the video output of the receiver must be discriminated before it can be utilized to reproduce a picture. The image information comes in at 400 lines of multiplexed infrared and visual data per minute. The discriminator output is fed through a scan converter and linearizer, before going to a modified photographic facsimile machine to be reproduced as either an uncorrected or linearized picture, with a line density of 256 lines per inch. This produces VHRR "quick-look" imagery in real-time as the satellite passes over the station. It is the output from this device which appears on the daily satellite photo display posted in the hallway adjacent to the Lab and is now used in the local TV weather presentation.

The output of the VHRR receiver is also directly recorded on a sophisticated tape recorder at 30 inches per second. A reel of half-inch magnetic tape some 12,000 feet in length is used to directly record the receiver output. One day's normal reception can be recorded on one channel of this 7-channel tape recorder.

The output of the tape recorder, or the direct live signal can be fed to a detector and de-modulator unit to be digitized onto the digital magnetic tape drive or memory disc of an Interdata 7/16 computer located in the Satellite Data Lab. In this computer, the data can be automatically manipulated in a variety of different ways depending on the programming. Infrared data can be compared with the visual data, a number of lines can be averaged, grey scale can be optimized or desired detail enhanced. Processed data can then be read out from the computer through a Computer-Fax Interface (CFI) to put the digital data into the required format to be reproduced on a photo facsimile unit operating at the APT rate of 240 revolutions per minute with 100 line density, or to a new photo-facsimile recorder that operates at either 120 or 240 rpm with a line density of 200 lines per inch.

These various outputs can now be switched to a research-dedicated photo-facsimile unit or fed through the normal APT reception system so that the SDL now has the flexibility to receive the Scanning Radiometer (SR) data, APT Vidicon data, or the re-transmitted "WEFAX" signals from either Advanced Technology Satellites (ATS), or a similar type of WEFAX data from the newer SMS-1 and SMS-2 Geostationary spacecraft in addition to accepting computer processed signals. (See Block Diagram)

BLOCK DIAGRAM S.D.L. GROUND STATION



With the ability to digitize the incoming signals and manipulate the data in the computer, before reproducing imagery, the Satellite Data Laboratory has the capability to reproduce satellite information directly to photographic prints in any format. This ability will make satellite data more useful for research or forecast applications. Additionally, computer output has also been sent over a telephone line circuit to Toronto International Airport and reproduced by a photo facsimile unit located there. The quality of the imagery received is the same as the reproduction obtained in the Satellite Data Lab. For this test, the image was digitized VHRR information at full resolution. The data was time-stretched so that it could be passed at full resolution to the operational forecast office. Similarly, VHRR data could be averaged in the computer and sent real-time to the airport for operational use. Specific areas of interest could in near real-time be time-stretched and transmitted at full resolution, with any suitable enhancement, if required as a follow-up.

The SDL ground station design has closely followed a NASA concept for an all-purpose type of ground station, so that when new sensors and formats, already planned for future satellites, are implemented, the station with slight modification or by a change in programming can accommodate the spacecraft design changes.

PRE-RETIREMENT SEMINAR

Toronto area, AES personnel, contemplating retirement during the next five years, attended four pre-retirement seminars in the auditorium of AES Headquarters during October. Each seminar, about 4 to 5 hours in length, was given to about 25 people; total attendance was 110.

The seminars were chaired by Mrs. Beverly Pow, Acting Area Personnel Manager, Ontario, and Miss Peggy Quinn, Personnel Services Officer, carried out the administrative arrangements. Miss Liz Arnott, Chief, Personnel Services Co-ordination Division, Ottawa very capably discussed with each group all the financial factors to be considered in making an informed decision regarding retirement.

The informative sessions included presentations and discussions on such topics as Canada Pension Plan, Old Age Security, Supplementary Death Benefit, Survivor Benefits as well as pensions and severance pay. Prior to the meetings, each participant received a booklet with appropriate reference material.

AES personnel, attending the seminars, greatly appreciated the efforts of Personnel in staging the discussions which made them aware of the options and monetary benefits available on retirement. On the basis of the success of this initial venture, it is anticipated that further pre-retirement seminars will be held as required.

FRANK W. BENUM RETIRES

Frank Benum has had a long and distinguished career in the Atmospheric Environment Service dating from September, 1937.

His strong leadership and his enthusiasm have resulted in major contributions to the development of the Canadian Weather Service.

Frank Benum was born in Superior, Wisconsin, in 1914, of Canadian Norwegian parents, attended school in St. Boniface, Manitoba, and graduated from the University of Manitoba with Honours in Mathematics and Physics. He joined the Meteorological Service in September, 1937, as a Weather Observer Grade 5, and was therefore one of those in at the beginning of the rapid expansion of aviation in Canada symbolized by Trans-Canada Air Lines' development of coast to coast service.

Mr. Benum took his Master's degree in Meteorology in 1939 at the University of Toronto, and spent the ensuing nine years in various forecasting assignments in western Canada.

In 1948 Frank was transferred to the Meteorological Branch at Headquarters where he filled a succession of positions:

– Superintendent of Continental Aviation Weather Services

– Chief of Forecast Division

– Director General Field Services

Frank's work as a member of the Commission for Synoptic Meteorology and as Chairman of the Working Group on Codes has contributed to the position which Canada has attained within the World Meteorological Organization.

Among Frank's many accomplishments were the:

– Organization of Field Services Directorate

– Expansion and strengthening of the Regional organization

– Development of the Presentation Technician concept

– Development of plans for the Three-Level Forecast System

– President of Working Group on Codes, Commission for Synoptic Meteorology, of the World Meteorological Organization.

Outside AES Frank Benum had a keen interest in Toastmaster International, skiing and hiking.

A farewell party was held for Frank and Irene in the Atmospheric Environment Service's Headquarters on September 24, 1975, when Mr. J.R.H. Noble presented Frank with an electronic calculator from his many friends throughout AES.

Frank Waldemar Benum

Mr. J.R.H. Noble presenting Frank Benum with calculator.
Monsieur J.R.H. Noble offrant à Frank Benum une calculatrice.

Miss Perreault (right) presenting Irene Benum with a bouquet of roses as Mr. Pincock looks on.
Mademoiselle Perreault (à droite) offre à Irène Benum un bouquet de roses tandis que monsieur Pincock observe la scène.

Photos Courtesy A. Blokhine
Les photos sont une gracieuseté de A. Blokhine

FRANK W. BENUM PREND SA RETRAITE

La longue et brillante carrière de F.W. Benum au Service de l'environnement atmosphérique débuta en septembre 1937.

Son leadership et son dynamisme ont fortement contribué au développement du Service météorologique canadien.

Frank Benum est né en 1914 à Supérieur, dans l'état du Wisconsin, de parents norvégiens naturalisés canadiens. Il fit ses études à St-Boniface, au Manitoba, et obtint un diplôme en mathématiques et physique avec grande distinction à l'université du Manitoba. En septembre 1937, il entra au Service météorologique comme météorologiste, groupe cinq, et fut donc l'un des pionniers lors de la rapide expansion de l'aviation canadienne représentée par le développement d'un service d'un océan à l'autre des lignes d'aviation transcanadiennes.

En 1939, Frank Benum obtint sa maîtrise en météorologie à l'université de Toronto et occupa, au cours des neuf années suivantes, divers postes dans l'Ouest canadien.

En 1948, il fut transféré à la Direction météorologique de l'Administration centrale où il occupa plusieurs postes:

- surintendant des Services météorologiques pour l'aviation continentale
- chef de la Division des prévisions
- directeur-général des Services extérieurs

Les travaux de Frank, en tant que membre de la Commission pour la météorologie synoptique et président du conseil d'administration du Groupe de travail sur les codes, a fortement aidé à élever le Canada au rang qu'il occupe présentement au sein de l'Organisation météorologique mondiale.

Voici quelqu'uns des apports de Frank:

- organisation des Services extérieurs
- expansion et renforcement de l'organisation régionale
- développement du concept des présentations fournies par les techniciens
- développement des projets du Groupe de travail sur les codes concernant le système de prévision à trois niveaux
- président du groupe de travail sur les codes et de la Commission de la météorologie synoptique de l'Organisation météorologique mondiale.

En dehors du Service de l'environnement atmosphérique, Frank avait un vif intérêt pour les clubs Toastmaster International, le ski et la marche à pied.

Une réunion d'adieu fut organisée en l'honneur de Frank et d'Irène à l'Administration centrale du Service de l'environnement atmosphérique, le 24 septembre 1975. A cette occasion, monsieur J.R.H. Noble lui a offert une calculatrice de la part de tous ses amis du SEA.

RETIREMENT – K.F. HARRY

On August 26, over 90 colleagues and friends attended a retirement dinner at the Dartmouth Curling Club for K.F. (Ken) Harry, Atlantic Regional Director AES. Mr. W.F. Ganong, Director, Ice Branch represented the Assistant Deputy Minister and presented a retirement certificate to Ken. Other distinguished guests included Dr. C.J. Edmonds, Chairman Atlantic Regional Board, DOE, Mr. G. Leach, representing Mr. T. Prescott Administrator CATA, and Mr. R. Fichaud Quebec Regional Director AES.

A number of presentations were made to Ken and Pat Harry, including the flags of the four Atlantic Provinces. Several humorous anecdotes from Ken's career were recalled by the various speakers and in particular a message from the Pacific Region attempted to set the record straight regarding hitherto unknown problems experienced by Ken while undertaking a familiarization flight.

Left to Right: Bill Ganong, Mrs. Pat Harry, Ken Harry at the presentation of a retirement certificate to Ken.
De gauche à droite: Bill Ganong, madame Pat Harry, Ken Harry à la présentation d'un certificat de long service à Ken.

Atlantic Regional Office Staff Left to Right: Bob Edwards, Gordon Shimizu, Al Dow, Des O'Neill, Jackie Clarke, Ken Harry, Nancy Comstock, Harold Humber and Ralph O'Brien.
Le personnel du bureau régional de l'Atlantique: de gauche à droite, Bob Edwards, Gordon Shimizu, Al Dow, Des O'Neill, Jackie Clarke, Ken Harry, Nancy Comstock, Harold Humber et Ralph O'Brien.

Ken and Pat will be setting up home in Duncan, B.C. and Ken plans to undertake some consulting work when the weather is unsuitable for sailing. We wish them both good luck and health in retirement.

RETIREMENT – A.F. MCQUARRIE

Allan F. McQuarrie, Officer-in-Charge of the Victoria Weather Office, Victoria International Airport, is retiring effective November 1, 1975, after 34 years service with the Atmospheric Environment Service.

Allan was born at Edson, Alberta, and received most of his schooling in Grande Prairie. He attended the Edmonton Normal School and taught school for six years in Northern Alberta. Subsequently, he attended the University of Alberta and worked for the Alberta Department of Highways for five years. In 1941, he was selected to attend the third World War II course for Meteorological Officers and served with the RCAF and RAF as Officer-in-Charge of several Prairie Meteorological Offices. He was one of the original fourteen Meteorological Officers chosen for overseas service but the end of the war cancelled that tour of duty.

Presentation/Présentation
Left to Right: Allan McQuarrie and John Knox.
De gauche à droite: Allan McQuarrie et John Knox.

Retirement Dinner/Dîner d'adieu
Left to Right: Allan McQuarrie, Jack Mathieson, Alice McQuarrie, Verne Benedictson and Marion Benedictson.
De gauche à droite: Allan McQuarrie, Jack Mathieson, Alice McQuarrie, Verne Benedictson et Marion Benedictson.

In 1945, he took over the Prince George Aviation Forecast Office and in 1948, opened the Calgary Aviation Forecast Office where he remained as Officer-in-Charge for 18 years. In 1966, he became Officer-in-Charge of the Victoria Weather Office, then at Gonzales Observatory, but from 1968 to the present at the Victoria International Airport.

Mr. McQuarrie is an honourary Life Director of the Calgary Flying Club, Fellow of the Royal Meteorological Society and a member of the Canadian Meteorological Society. For eight years, he was Meteorological Instructor on the staff of the Ministry of Transport Pilot Instructor Refresher Courses.

He has been interested in photography all his life, is a director of the Color Photographic Association of Canada and was General Chairman of the National Convention held in 1969. So photography, "along with a little sailing", will continue to interest him.

He is married to the former Alice Fleming of Edmonton; they have two daughters, Donna and Mrs. P.R. (Shirley) Shires.

A retirement dinner for Mr. and Mrs. McQuarrie was held on August 29 and attracted 65 friends and colleagues. Presentations were made by John Knox, Regional Director; and Jack Mathieson, Regional Superintendent, General Weather Services; and by Doug Fink and Dennis Gallagher of the Victoria Weather Office. A unique feature of the evening was a tape recording complete with band and vocalist specially prepared by a Victoria Radio Station honouring Allan McQuarrie's radio weather broadcasts which have attracted such large audiences in the Greater Victoria area for many years. Allan and Alice McQuarrie plan to continue living in Victoria.

TORNADOS AND FLOODING AT REGINA

by

Larry S. Romaniuk

June 25, 1975 was the warmest day of the month in Regina with the temperature reaching a near record 34 degrees. That evening the day came to a dramatic close as nearly 6 inches of rain deluged the city in less than 6 hours causing widespread flooding and some 12 million dollars worth of damage.

Because of the intensity and suddenness of the storm, sewers backed up and water inundated the majority of basements in the city, in some cases to a depth of 4 to 7 feet. Traffic came to a halt over most of the city as streets and underpasses filled with water and cars stalled in deep pools. To add to the hardship lightning played havoc with telephone and communication lines and also severed the power supply which left the city in darkness for several hours.

At least 12 hours prior to the storm forecasters in Regina had indicated "a chance of severe thunderstorms with hail and strong winds" in the Public Forecasts. Although it was known that the potential for severe thunderstorms and perhaps tornados existed, forecasters began having doubts by 2 PM when hardly a cloud was being reported in the sky for hundreds of miles around.

However by 4 PM events took an ominous turn. Within minutes thick heavy cumulus and burgeoning thunderheads filled the sky. Light showers began falling. By 5:30 PM cumulonimbus clouds, with tops estimated to reach 58 thousand feet, were common in the area and it was at this time that residents watching the northwestern sky were treated to a rare spectacle as a family of tornados began writhing across the horizon.

The Weather Office immediately issued a "Tornado Warning" and soon afterwards was deluged with phone calls from alarmed citizens anxious to know what precautions to take. No doubt, still fresh in the minds of local residents was the thunderstorm which occurred 5 days earlier and had brought hail and flood damage to sections of

One funnel cloud begins to decay while a second one forms. ...
Une nuage en entonnoir se dissipe, un autre se forme . . .

And develops . . .
se transforme . . .

Into a full fledged tornado . . .
en une véritable tornade . . .

And brushes by the city .
et frôle la ville.

Photos Courtesy of L. Romaniuk
Les photos sont une gracieuseté de L. Romaniuk

Flooded subway in Regina, Saskatchewan on June 26, 1975 following a 5.98 inch rainfall in a 6 hour period.
Un métro inondé à Régina, en Saskatchewan, à la suite d'un volume de précipitations de 5,98 pouces en 6 heures, le 26 juin 1975.

Photo Courtesy of Regina Leader Post
Les photos sont une gracieuseté du Regina Leader Post

the city. When the tornados moved off an hour later, the city breathed a sigh of relief. Thunderstorms still rumbled, but the height of the danger appeared to be past.

Then at 8 PM disaster struck as torrential rains began falling and continued unabated until midnight. By this time a record breaking 5.22 inches had fallen. The thunderstorms continued sporadically into the morning of the 26th and at the end of the day the total rainfall stood at 6.04 inches.

Oddly enough a "bucket survey" carried out just after the storm showed that amounts of less than one inch were recorded from localities less than 20 miles southeast and northwest of the city.

In the days and weeks that followed the city was forced to cope with street cave-ins, water contamination, transportation and communication disruptions and of course the major clean-up problems resulting from what can easily be called the "worst summer rainstorm in living memory" at Regina.

VIZ MANUFACTURING CELEBRATES ITS THREE MILLIONTH RADIOSONDE

The Viz Manufacturing Company which supplies radiosondes and component parts to meteorological services in thirty-four countries, recently celebrated the production of its three millionth radiosonde. To commemorate the event, meteorologists from many parts of the world attended special ceremonies at the Viz plant in Philadelphia, Pa. The Atmospheric Environment Service was represented by Mr. J.R.H. Noble who was one of the guest speakers at the event.

– THEN –

"EXTENSIVE COURSE IN METEOROLOGY" – 1942

"COURS INTENSIF EN METEOROLOGIE"– 1942

Front Row:/Première rangée: R.V. Tyner, W.L. Godson, H.S. Keendyside, R.D. Butterill, W.L. Gutiererrez, R.W. Glenn, J.L. Knox, M.R. Fleming, L.A. Cooke, R.W. Walkden
Second Row:/Deuxième rangée: W.E. Markham, L.R. Mumford, L.G. Tibbles, B.W. Boville, H.M. Greb, A.B. Wright, W.M. Cameron
Third Row:/Troisième rangée: H.C. Belhouse, R.R. Dodds, A.R. McCracken, T.L. Richards, K. Buckthought, K.F. Harry, H.W. Fleming
Back Row:/A l'arrière: W.G. Clark, E.N. Ellis, R.E. Munn, D.E. Page, E. Einarsson, L.T. Campbell, W.F. Ganong.

EXHIBITION OF PAINTINGS

A collection of 44 oil paintings by Les Tibbles has been on display in the library at AES HQ. The group includes a wide range of subjects from abstracts to woodland sketches and snow scenes.

Some paintings in Exhibition.
Quelques toiles exposées.

Les Tibbles – Artist at work.
Les Tibbles – L'artiste à l'oeuvre.

Photos Courtesy of A. Blokhine
Les photos sont une gracieuseté de A. Blokhine

Highlight of the exhibit was North of Resolute, an impressionistic semi-abstract showing ice floes, an open lead of deep blue water and an Arctic island. Les developed the idea for it while flying north from Resolute to the pole. In other paintings such as Southwest Wind-Lake Cecebe, Aspens-Fenlon Falls and Grey Woods-Terra Cotta, Les shows his love of the outdoors and the strong influence the work of the Group of Seven and Tom Thomson have had on his paintings.

Pictures of historic interest were Night PIBAL-Gander which depicts the meteorological observer silhouetted against northern lights and the night sky preparing to release a pilot balloon to measure the winds aloft. The picture has been done using a glaze technique to impart a crystal quality to the night sky and snow; and Gander Teletype-Circa 49 which shows the teletype operator typing out a weather message in the Gander teletype office at the time of Newfoundland's Confederation is done in a cubist style to produce a three-dimensional effect.

Four abstracts, Etudes 1 to 4, rounded out the exhibit providing a touch of colour and variety. Credit goes to Bill Rolph of the library who suggested the exhibition and assisted in hanging the pictures.

1976 TEST FOR AUTOMATED SHORT-RANGE STORM PREDICTION

Every half hour an automatic forecast of rainfall in the next few hours – when it will begin, when it will end, how much will fall and how fast. That is the scheme to be tried out in an operational setting next summer in Montreal using the McGill radar under an AES contract with McGill University. The contract represents the implementation of technique-development work conducted in the last few years by the Meteorological Services Research Branch (MSRB) and by Prof. G.L. Austin of the Stormy Weather Group. Quebec Region and the Montreal Weather Office will be participating in this six month test which is being funded by the MSRB and the Field Services Directorate with an important boost from a special funding policy of the Department of Supply and Services, under which unsolicited proposals may be funded to help a project in line with a Department's objectives.

A mini-computer at McGill will store all the information gained from a good five-minute look at the whole sky, condense and organize the information, project it forward on the basis of past motion and other considerations, and interpret the result in terms of expected onset-ending times and intensity. The results will be sent every half-hour to a special computer terminal in the Montreal Weather Office or to the mini-computer in that office. In addition there may be one or more other outlets to special users.

Preparation for the test has been underway since the beginning of September, and regular operations will run from April to September. These will be followed by a six-month evaluation.

The scheme is dubbed "SHARP" for Short-range Automated Radar Prediction, and has been found in preliminary testing to have very useful accuracy on most occasions and to be a practical task for a mini-computer. The software and other aspects are required to be developed to have the potential of meshing readily with the new AES remoting of weather radar using the SCEPTRE System.

GREAT LAKES STUDIES CRUISE – ATMOSPHERIC ENVIRONMENT SERVICE

METEOROLOGICAL STUDIES OF LAKE ONTARIO SEPTEMBER 8 TO 12

Atmospheric Environment Service personnel participated in a cruise of Lake Ontario aboard the M/V Northern Seal September 8 to 12. The purpose of the cruise was to carry out a check of the MARS installations on Lake Ontario, visit the site of the 1976 Olympic Sailing events at Kingston and to assess the availability of meteorological information on Lake Ontario.

Left to Right: R.R. Youakim CCIW, D.J. Phillips AES HQ, G. Rideout Toronto Weather Office, T.L. Wiacek Toronto Weather Office, L. Bertolone Toronto Weather Office, B. O'Donnell Toronto Weather Office, G. Payment AES HQ and D.W. Phillips AES HQ.
De gauche à droite: R.R. Youakim, Centre canadien des eaux intérieures, D.J. Phillips, siège central du Service de l'environnement atmosphérique, G. Rideout, bureau météorologique de Toronto, T.L. Wiacek, bureau météorologique de Toronto, L. Bertolone, bureau météorologique de Toronto, B. O'Donnell, bureau météorologique de Toronto, G. Payment et D.W. Phillips, siège central, Service de l'environnement atmosphérique.

IN MEMORIAM

It is with regret that we learned of the passing on September 11, 1975 of Frank B. Angelopoulos, recently Head of the Air Canada Dispatch Office in Montreal. Frank will be remembered by his many friends in the Weather Service during the post war years at Gander and Montreal and for his special interest in weather service for aviation.

PERSONNEL

The following have accepted positions as a result of competitions:

Les personnes suivantes ont accepté ces postes après concours:

75-DOE-WIN-CC-518	Officer-in-Charge Isachsen EG-ESS7 F. Anderschuck
75-DOE-WIN-CC-518	Officer-in-Charge Eureka EG-ESS7 H.E. Powers
75-DOE-WIN-CC-537	Officer-in-Charge Armstrong EG-ESS4 P.D. Charbonneau
Promotion without Competition Promotion hors concours	Observer Presentation Technician EG-ESS5 F.L. Turner
CF Promotion	Exchange Officer Colorado Springs Major R. Winterer
75-DOE-WPNA-CC-067	Meteorological Inspector – Surface EG-ESS6 M.J. Koroluk

The following transfers took place:
Les transferts suivants ont été effectués:

P. Chen	From:De Pacific Weather Central To:A CFWO Cold Lake
B.M. Burns	From:De ADMA Toronto To:A Edmonton Regional Office
L.C. Dixon	From:De Norman Wells To:A Fort Nelson
D.J. Bentley	From:De Colorado Springs To:A Edmonton Weather Office
J.U. Godin	From:De Suffield, Alberta To:A Edmonton Regional Office

D.R. Turchanski	From:De Fort Nelson To:A Port Hardy – Upper Air Station
G.A. Dye	From:De Fort Smith To:A Suffield, Alberta
D.A. Dueck	From:De Toronto International Airport To:A Edmonton International Airport
J.M. Bullas	From:De CFB Winnipeg To:A Winnipeg Weather Office
C.E. Klaponski (Miss)	From:De CFB Comox To:A Toronto Weather Office
T.R. Nichols	From:De CFB Cold Lake To:A CFB Edmonton
J. Gariéty	From:De Winnipeg Weather Office To:A CFB Winnipeg

The following are on temporary duty or special assignment:
Les personnes suivantes occupent temporairement ces emplois ou sont en stages spéciaux:

G.M. Rideout	From:De Toronto Weather Office To:A CFB Trenton
J.D.M. Marcotte	From:De CFB Bagotville To:A MOTTI Ottawa

Separations
Demissions

G.E. Lokken	Resigned
C.M. Dobbe	Resigned
R.A. Potter	To Ministry of Transport
L.W. Johnson	To Department of Supply and Services
K.F. Harry	MAED Regional Director Retired August 29, 1975
F.W. Benum	Director General, Field Services Directorate, AES HQ. Retired September 30, 1975

The following are recent Graduates from MOTTI – Ottawa:
Nouveaux diplômés de MOTTI – Ottawa:

R.R. Pilotte	To: Armstrong
C.J. Schwab	To: Estevan
V. Gossen	To: Atikokan
D. Letters	To: Gimli

TRIVIA

Cars are dividing people into two classes – drivers and dodgers.

* * * *

Any road to success is constantly under construction.

* * * *

Whiskers are the only sure thing that will come to the man who waits.

* * * *

He who believes that where there's smoke there's fire hasn't tried cooking on a camping trip.

* * * *

Une liste d'expressions diverses

Expression	Signification ou équivalent
Il se fait passer un sapin	Il fait une mauvaise affaire
Bayer aux corneilles	Regarder en l'air niaisement
Faire venir l'eau à la bouche	Faire naître un vif désir d'une chose
Etre gratteux	Etre avare
Prendre le mors aux dents	S'énerver
Prendre les nerfs	Faire une colère
Sacrer son camp	S'en aller
Mener quelqu'un par le bout du nez	Le mener à sa guise
Tirer les vers du nez de quelqu'un	Le faire parler
Mener le diable	Etre turbulent