Chinook

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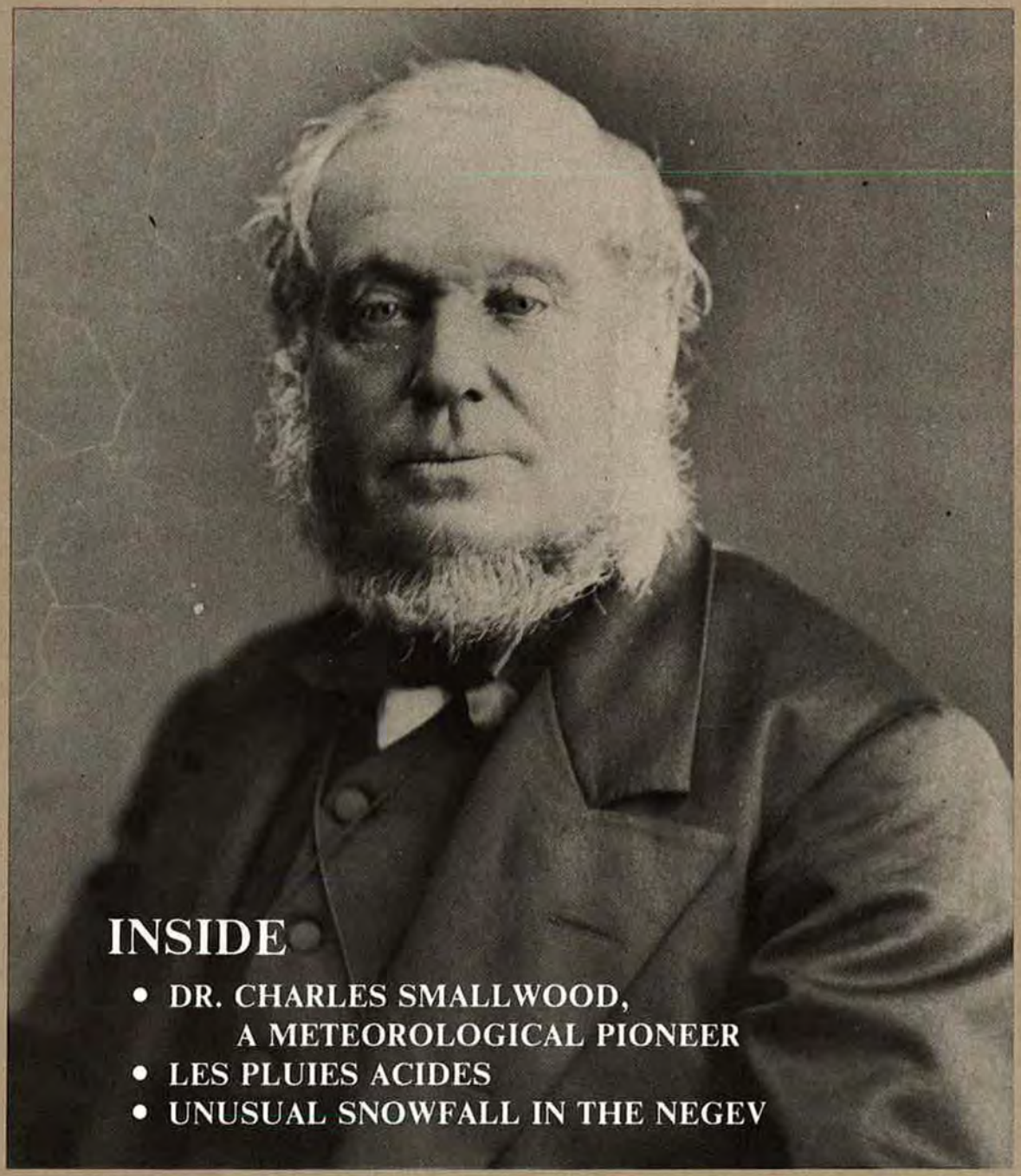

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Chinook

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Articles

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THE COVER

Dr. Charles Smallwood was a true Canadian meteorological pioneer who has received very little acclaim for his life's work. His achievements included the design, construction and operation of a unique and original observatory at Île Jesus, Quebec, and later the founding of McGill Observatory in Montreal. He wrote numerous scientific papers concerning meteorological matters, published his observatory records, was appointed a professor of meteorology, and was a moving force behind the establishment of an official meteorological service in Canada. Yet not only did he make his mark in our meteorological history, but also found the time and energy to become a noted physician. For more about this remarkable man see the story on page 56.

The cover photograph of Dr. Smallwood was taken in 1872 (3 years before his death). Notman Photographic Archives no. 73424-BI McCord Museum, Montreal.

THE IMPORTANCE OF WEATHER SATELLITES TO BRITISH COLUMBIA

by Louis Legal

The science of weather forecasting in Canada has made significant advances with the arrival of the computer age. There are fewer forecast failures, and fewer storms missed today compared to the past. However, weather systems in British Columbia arrive mainly from the remote and empty stretches of the Pacific, and predicting the vagaries of the weather in this province remains a very inexact science. This is because accurate prediction relies upon a good knowledge of the present state of the atmosphere. Unfortunately, insufficient data over the Pacific Ocean often makes this requirement difficult to achieve. In order to help remedy this information gap, a greater reliance is placed upon weather satellite data than perhaps anywhere else in the country, and a satellite unit has been in operation at the Pacific Weather Centre in Vancouver for some time.

The satellite meteorologist is a specialist responsible for interpreting satellite images and analysing fields of data derived from them. The information gained from this process is used primarily within the Weather Centre to assist in the production of weather forecasts and warnings for mariners, aviators, and the public, as well as for forestry and agricultural interests.

Perched 35,800 km above the equator in an orbit which is stationary in relationship to the earth, the Geostationary Operational Environmental Satellite — West (GOES-W) transmits half-hourly pictures which are available at the Pacific Weather Centre. Because of the altitude from which they are taken, GOES pictures tend to lose detail, but because of their half-hourly frequency and fixed frame of view, they can be animated in a time-lapse sequence on video tape. This provides the forecaster with the considerable advantage of being able to view and measure moving weather patterns, and to identify and locate circulation features in the atmosphere. Twice a day, pictures with much better detail are received from the Television and Infrared Observation Satellite (TIROS). It circles the earth at a height of 800 to 900 km and each orbit carries it across the earth's poles from north to south.

Pictures from both satellites consist of visual and infrared images. Visual pictures are simply black and white depictions of clouds and the earth's surface taken from above and are very useful for pinpointing fog or low cloud in the interior valleys or along the coast of B.C. (for an example of a

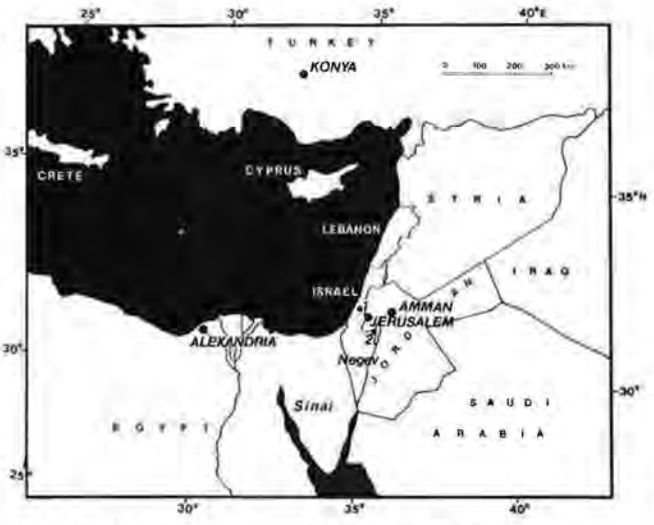
Continued p. 59

If these olive trees in the Garden of Gesthemane, Jerusalem, could talk, they would recount many other instances of snow in their 2000 year lifetime. On this occasion, March 2, 1980, the remnants of an unusual 15 cm snowfall linger on the east slope of Mt. Moriah among the monuments of the Muslim Cemetery, and on the floor of the Kidron Valley. At top left is the Mosque of Omar (Dome of the Rock), on the right is the Eastern Gate (Golden Gate), sealed until the arrival of the Muslim Messiah. Jerusalem is built upon a series of hills and snow fell only upon those sections of the city above 750 metres in elevation. Photo by Dr. William H. Jones.

UNUSUAL SNOWFALL IN THE NEGEV DESERT, JERUSALEM AND AMMAN

by A.F. Davies

Fifteen centimetres of snow fell at Jerusalem on March 2, 1980. At Amman, in Jordan, a sixty year record was broken by a snowfall of thirty-eight centimetres. In the Negev desert, snow fell at elevations of 900 metres. At En Gedi, Israel, flood waters rushed down the ravines leading to the Dead Sea sweeping everything along in their path. This unusual precipitation did not occur in an over-running (warm frontal) situation, as might be expected from familiarity with Canadian weather. Instead, weather reports showed that the rain and snow were the result of convective development.



GEOGRAPHICAL REFERENCE MAP. The location numbered 1 is Bet Dagan, and location number 2 is En Gedi.

On the evening of March 1st, thundershowers were reported from Lebanon as a Polar cold front approached from the north, and also from the island of Crete due to an Arctic front following about 350 km behind. Twenty-four hours later the first cold front had crossed Turkey, Syria, Israel and northern Egypt, to lie in an arc from Iran to the Sinai peninsula. Thundershowers were reported from the Nile delta and the Gaza strip, snow was falling in Jerusalem, Amman, and the mountains of Lebanon, and the temperature at Konya, Turkey fell below freezing to -2°C.

Even on the evening of March 3rd, with the cold fronts 600 km east of Jerusalem and crossing the Arabian desert, thunderstorms were still being reported from Syria, Jordan, and the Negev. The precipitation finally ended as a high pressure ridge moved rapidly southeastward from its position over Crete on the evening of the 3rd, to an east-west line through Jerusalem, Amman, and Alexandria by midnight Monday, March 4th.

The prelude to this extreme weather event was a highly meridional (south to north and back to south) flow of air around the northern hemisphere at high levels in the atmosphere. This type of circulation usually results in a number of completely closed atmospheric eddies from which all the warmer air has been expelled. In this instance, six of these cold-cored low pressure systems could be found at latitudes between 38°N and 53°N, and three similar centres near 75°N over Siberia, Iceland and the Canadian arctic.

On March 1, 1980, one of these cold low pressure systems was centred over the Black Sea with a central height of 5200 metres and a temperature of -39°C at the 50 kilopascal level (the approximate level at which the atmosphere is divided vertically into two equally dense halves). This low moved southeastward at a speed of about 30 km/h (7 degrees of latitude per day) reaching central Turkey on March 2nd, Iraq on the 3rd, and in the process caused a significant lowering of temperatures at mid-levels of the atmosphere around the eastern end of the Mediterranean sea. At Bet Dagan, near Jerusalem, for example, the temperature at the 50 kilopascal level fell from -25°C to -30°C in twelve hours on March 1st. On the evening of March 3rd it was at its coldest (-32°C), then recovered to -20° in a further twenty-four hours.

The destabilization of the atmosphere caused by this temperature decrease at mid-levels was still further enhanced due to low-level heating of the arctic airmass by the 17.5°C sea surface temperatures of the Mediterranean. Sub-zero air from Turkey, warmed in this fashion, arrived at Bet Dagan with a surface temperature of 8.5°C. The instability resulting from the lowering of temperature at 50 kilopascals, and the heating at the surface is indicated by the Total Totals Index, a parameter used in thunderstorm forecasting. In North America, a value of this index of 46 usually corresponds with thunderstorm activity, and with severe thunderstorms for values greater than about 52. The Total Totals Index at Bet Dagan was 64 on March 1st, and 57 the following day. With such extreme instability, abundant moisture provided by the sea surface, as well as vigorous lifting of the airmass by the cold fronts, and by the terrain which slopes from sea level to 800 or 1000 metre elevations at Jerusalem and Amman, convective development was inevitable. However, with above freezing temperatures near the ground, we still have to explain why the precipitation fell as snow.

Examination of the upper air soundings at Bet Dagan showed a freezing level of 1500 metres above sea level on both March 1st and 2nd. The wet bulb zero height lowered from 900 metres to 500 metres during that twenty-four hour period. So, even though surface temperatures at Bet Dagan were near 8°C, Jerusalem, Amman, and many other localities were at elevations close enough to the freezing level, and thunderstorm downrush temperatures were low enough, that the precipitation fell as snow. With abundant moisture available, and repeated thunderstorm activity, the precipitation amounts of about 13 mm to 38 mm (liquid equivalent) were to be expected.

The writer is indebted to Dr. Y.L. Tokatly, Director of Meteorological Services, Israel, and his staff for surface and upper air charts and tephigrams. Also to Dr. M. Jacobs, Director, Hydrological Services, Israel, and his staff for the information provided by personal interviews in May 1980, upon which this article is based.

LES PLUIES ACIDES par Claude Masse.

Depuis quelques années, il n'est pas rare de rencontrer un article portant sur les pluies acides, en parcourant les journaux, revues ou autres. Certains peuvent se demander avec raison, si les précipitations se sont acidifiées que depuis quelques temps; bien que Likens, un chercheur américain, ait souligné qu'il y a eu effectivement une augmentation plus rapide dans le processus d'acidification des précipitations, pendant les 2 ou 3 dernières décennies au Canada et dans le nord-est américain. Le problème des pluies acides trouve sa source dans le milieu du siècle passé, avec l'avènement de la révolution industrielle en Angleterre.

Jusqu'à cette époque, l'homme avait fait usage de la force physique, animale ou naturelle (moulin à vent ou à l'eau), afin de pourvoir à ses besoins énergétiques. Avec l'industrialisation rapide, il a commençé à utiliser des combustibles fossiles (charbon, pétrole), pour subvenir à la nouvelle demande d'énergie. L'on pensait alors que la pollution de l'air, causée par les émissions de fumée, était un inconvénient mineur comparée aux bienfaits apportés par la technologie nouvelle. Des cheminées crachant de la fumée noire, représentaient jusqu'à un certain point, le symbole de la prospérité d'une ville ou d'une région.

Cependant, certains contemporains de l'époque avaient déjà commencer à remarquer les effets néfastes de la pollution de l'air sur l'esthéthique de l'environnement tels que: la réduction de la visibilité, l'odeur désagréable de certains gaz, la perte des contrastes des couleurs, le salissage des immeubles et des statues etc... Ces aspects ont été identifiés dès le début de l'ère industrielle; par contre, il a fallu plus de temps pour reconnaître les effets des polluants atmosphériques sur la santé de l'homme, bien que l'on se doutait depuis de nombreuses années que ceux-ci étaient en partie responsables des maladies respiratoires (bronchite, cancer du poumon, etc...). Ce n'est qu'après une épisode grave de pollution atmosphérique qui s'est abattue sur Londres, entre le 5 et le 9 décembre 1952, que l'on a reconnu que la pollution de l'air représentait une menace sérieuse à la santé humaine. Des études épidémiologiques ont montré que l'exposition prolongée à des niveaux très elevés de dioxide de soufre (SO_2) avait causée la mort de 4,000 londoniens.

Après cet évènement malheureux, les autorités gouvernementales de ce pays ont établies des normes sur les niveaux de polluants à ne pas dépasser. Cette tendance s'est répandue dans les autres pays

Gracieuseté d'Environnement Canada

La photo du haut montre de jeunes poissons sains dans une eau de pH normal. Par contre sur la photo du bas, des oeufs de poissons sont incapables d'éclore et de se développer normalement dans une eau de bas pH. Conséquemment, la disparition des populations de jeunes poissons d'un lac est un signe avant-coureur de la mort d'un lac.

industrialisés. Les deux solutions envisagées pour réduire la concentration des polluants près du sol, étaient l'utilisation d'un combustible plus propre et l'augmentation de la hauteur des cheminées. On a alors préféré le pétrole léger au charbon et construit les cheminées d'usines plus élevées pour permettre aux polluants d'être dipersés par les vents de plus grande vélocité en altitude. Par cette seconde mesure, on venait de résoudre un problème de pollution locale, en favorisant une meilleure dilution des polluants dans l'air, mais on en créa un autre à l'échelle régionale et continentale soit: les précipitations acides.

Avant l'ère industrielle, les précipitations étaient faiblement acides avec une valeur de pH de 5.6. Ce dernier résulte de l'équilibre chimique entre la vapeur d'eau, les gaz atmosphériques et le dioxide de carbone (CO_2), pour former une solution diluée d'acide carbonique (H_2CO_3). Des mesures faites sur échantillons de glace vieille de près de 200 ans et provenant de glaciers, confirment cet équilibre chimique, en Europe les valeurs de pH sont généralement supérieurs à 5 et au Groëland ils varient entre 6 et 7.6.

Les deux principaux produits résiduels de la combustion l'anhydride sulfureux (SO_2) et les oxides d'azote (NOx), qui sont responsables de l'acidification des précipitations, sont venus briser l'équilibre chimique existant. En étant transportés sur de grandes distances, l'anhydride sulfureu et les oxides d'azote, dû à leur plus longue période de résidence dans l'atmosphère, peuvent se combiner aux gouttelettes d'eau pour former une solution d'acide sulfurique (H_2SO_4) et nitrique (HNO_3). Ces nouveaux acides, additionnés à l'acide carbonique, ont changé de facon marquée la composition chimique des précipitations du passé. Sur la carte de l'Amérique, les valeurs annuelles moyennes du pH varient entre 4 et 4.5 au-dessus de vastes régions densément industrialisées de l'est canadien et du nord-est américain. Durant une averse, un pH de 2.4 (vinaigre 2.2) a été enregistré en Ecosse, en 1974.

Une fois émis, les polluants sont transportés sur de grandes distances par le vent moyen dans la couche limite, après s'être fait mélangés dans les bas niveaux de l'atmosphère par turbulence thermique et dynamique. Le transport de ceux-ci, ne respectant pas les frontières entre pays, soulève des problèmes politiques très importants si un certain pays veut prendre action pour contrôler ce genre de pollution. Par exemple, les pluies acides sont devenues un dossier prioritaire de négociation entre le Canada et les Etats-Unis. Les Etats-Unis sont les plus importants producteurs d'anhydride sulfureux au monde avec des émissions de 30 millions de tonnes contre 5 millions pour le Canada. Les vents dominants du sud-ouest et de l'ouest charient ces polluants vers l'Ontario, le Québec et les provinces maritimes. M. Douglas Whelpdale, chercheur scientifique au service de l'environnement atmosphérique, a souligné qu'avec les connaissances scientifiques actuelles, l'on estime que les Etats-Unis seraient responsables pour approximativement la moitié des pluies acides au Canada. En contre partie, le Canada serait responsable de 10 à 15% des retombées acides aux Etats-Unis. Ce qui veut dire: que le Canada ne peut résoudre ce problème

sans avoir fait une entente sur un plan d'action conjointe entre les deux pays.

L'acidification des lacs est l'effet le mieux connu et le plus largement discuté. Quand le pH d'un lac se situe entre 4.5 et 5, un certain nombre d'espèces de poisson ne peuvent plus continuer à se reproduire et disparaissent définitivement. Si le pH descend en deçà de 4.5, la survie de la plupart des poissons est compromise. La sensibilité d'un lac aux pluies acides est déterminée par la composition chimique de l'eau du lac ainsi que du sol environnant. Les lacs reposant sur un lit de pierres calcaireuses, peuvent neutraliser plus efficacement les retombées acides. Les lacs de l'Ontario et du Québec, situés dans le bouclier canadien, ont une faible capacité de neutralisation. Une étude menée par le ministère de l'environnement de l'Ontario, a indiqué que 48,000 lacs d'ici 10 ans, vont atteindre un niveau d'acidité trop élevé pour supporter la vie des poissons. Dans les provinces maritimes, le saumon de l'atlantique, poisson particulièrement sensible à l'acidité de l'eau, serait disparu de quelques rivières et si la tendance se continue, il pourrait disparaître complètement de toutes les rivières. Les impacts sociaux-économiques ne sont pas à négliger, tels la disparition de la pêche sportive, la perte de la pêche commerciale ainsi que d'un style de vie etc...

Une autre industrie d'importance au Canada qui pourrait être mise en danger, est l'industrie des pâtes et papiers. De grandes réserves de forêts, indispensable à cette industrie, sont situées sur le bouclier canadien dont les sols ont une faible capacité de neutraliser les retombées acides. L'on craint que les sols soient lessivés d'éléments essentiels au développement des arbres. Ces effets sont encore malconnus et parfois contradictoires, comme dans le cas du cycle de transformation de l'azote, les nitrates contribuent à la croissance des arbres.

D'autres recherches ont portées sur les effets possibles sur l'agriculture. L'on ne croit pas que les sols en culture soient acidifiés dans un avenir rapproché. Une épaisse couche de sol arable agissant comme tampon pour le surplus d'acidité, est généralement présente sur les terres cultivées. De plus, les agriculteurs peuvent changer l'acidité de leurs sols par l'épandage de poudre de chaux. Cependant un effet indirect existe, soit la production d'ozone qui résulte de la transformation chimique des oxides d'azotes et des hydrocarbures en présence de la lumière solaire. Le tissus végétal de plusieurs plantes (fève, blé d'inde, vigne, comcombre etc...) est endommagé quand il subit des expositions répétées et prolongées de hauts niveaux d'ozone dans l'atmosphère.

Un autre impact des pluies acides est l'effet corrosif sur les édifices, augmentant les coûts d'entretien d'une façon marquée. De plus notre héritage culturel est atteint, les statues de bronze et de pierre ainsi que les monuments historiques se sont déteriorés plus rapidement pendant les dernières 50 années que par les siècles passés.

Comme on peut s'en rendre compte, les impacts de ce genre de pollution sur l'environnement posent des problèmes de taille à court et à long terme. Au siècle dernier, l'atmosphère était considérée comme un vaste réservoir illimité pour les polluants atmosphériques et l'on ne se doutait pas qu'il puisse y avoir des effets néfastes sur sa composition chimique et sur les écosystèmes. Aujourd'hui, on estime que la dilution des polluants atmosphériques ne suffit plus et qu'il faut s'orienter vers un contrôle des quantités émises aux sources. Plusieurs techniques existent pour réduire ces émissions (désulfuration du pétrole, réduction chimique de l'anhydride sulfureux et des oxides d'azotes, dépoussièreur électrostatique etc...) avec leurs efficacités et leurs coûts relatifs. Au Canada, le gouvernement est bien décidé d'imposer des mesures plus restrictives sur les sources tels que les usines, le transport et autres sources de pollutions. Par contre aux Etats-Unis, la nouvelle administration Reagan va favoriser l'utilisation du charbon dans le but de réaliser l'indépendance énergétique ce qui aura pour effet, d'augmenter les quantités émises. D'autres choix existent, on pourrait s'orienter vers d'autres sources d'énergie, soit l'utilisation du nucléaire qui pourrait contribuer d'une façon importante à la réduction des émissions de SO_2 et NOx. Dans le cas de l'industrie du transport, l'utilisation de l'hydrogène pourrait devenir un combustible économiquement rentable dans quelques années et souhaitable pour l'environnement.

Cette carte représente les valeurs moyennes annuelles du pH des précipitations en Amérique du nord. On s'aperçoit que des précipitations fortement acides de pH de 4.0 à 4.5 affectent de vastes régions du Canada qui sont pourtant éloignées des grands centres urbains, confirmant le transport des polluants sur de grandes distances.

Les solutions existent aux problèmes des pluies acides; ce qui est réellement mis en question, ce sont les coûts supplémentaires imposés sur l'économie qui est déjà chancelante depuis quelques années. Par contre, si aucune action n'est prise, les coûts sociaux et économiques sur l'environnement pourraient s'avérer plus onéreux à long terme. Il faut donc continuer la recherche dans ce domaine afin de déterminer des niveaux acceptables de polluants atmosphériques pour l'environnement et l'économie. Cela est un défi de taille, mais si on peut réussir à établir une tendance vers cet équilibre, on pourra continuer de jouir dans l'avenir, d'un environnement sain et d'une économie prospère.

UN MOT DU REDACTEUR

Deux francophones mis à l'honneur.

Chinook voudrait féliciter les récipiendaires du prix annuel de la *Société de Météorologie de Québec*. La société a décernés exceptionnellement deux prix annuels qui ont été à *M.G. Paulin* et *M.G. Soucy*. Le prix de la société se veut une reconnaisance pour leurs travaux voués au progrès de la météorologie.

Le président *M.R. Leduc* et le vice-president *M.C. Lelièvre* ont remis les prix lors de l'assemblée annuelle le 13 juin dernier.

M.G. Paulin s'est mérité ce prix pour ses réalisations autant en recherche qu'en météorologie appliquée, de plus, il a grandement contribué au developpement de la météorologie chez les francophones.

M.G. Soucy a été trésorier de cette société depuis 1972. Son travail dévoué a grandement contribué à consolider cette société et à favoriser son épanouissement.

Par la même occasion, l'équipe de ***Chinook*** voudrait remercier les membres de cette société pour leur intérêt porté à notre revue. Toute personne interresé à joindre cette peuvent contracter le rédacteur français de ***Chinook***. *M.R. Leduc* invite toute personne à soumettre des candidatures pour le prix annuel de la société.

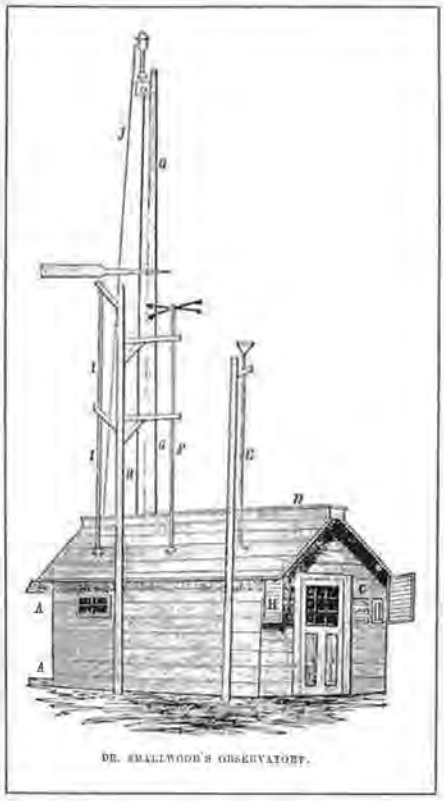
DR. CHARLES SMALLWOOD, A METEOROLOGICAL PIONEER

by Scott Somerville

In a previous issue of Chinook (Winter 1979) I wrote an article concerning the meteorological contributions of Dr. Joseph Workman, a 19th., century physician trained at McGill University in Montreal. A contemporary of his, Dr. Charles Smallwood, also a practicing physician and also associated with McGill University, was a pioneer meteroologist who has received little credit for his work. Through his unpaid singlehanded efforts, he helped foster the growth of meteorological science in Canada and established the tradition of meteorology at McGill University which continues to this day.

Dr. Charles Smallwood was born in Birmingham, England in 1812. After receiving an M.D. degree from University College, London, he emigrated to Canada in 1833 settling temporarily at Huntingdon, Lower Canada. When he arrived, Dr. Smallwood began his tandem meteorological career by keeping a weather notebook. Once he had received a licence to practice medicine on July 16, 1834, he established a residence and medical office at St. Martin, Isle Jesus, just west of Montreal. About 1841 he built with his own hands and ingenuity, an elaborate weather observatory at St. Martin that would rival any experimental station of the time, and perhaps even some of today. It was a small wooden building which housed an array of instruments, with yet others located on the grounds outside. There were four barometers, several thermometers which were properly placed four feet (1.2 m) above the ground and shielded from the sun's rays, two psychrometers, an anemometer, as well as rain and snow guages. Besides these, Dr. Smallwood also developed intriguing methods of measuring dew, evaporation, atmospheric electricity and ozone. During the winter he collected snow crystals which he examined by microscope and even photographed. Another important feature of his observatory was a 7 inch telescope with which he scanned the skies on favorable nights.

Meteorological observations at St. Martins were recorded regularly at least five times daily and if there were any unusual weather events, special observations and notes registered the phenomena in the observatory record. Because of his specific interest in atmospheric electricity, three



DR. SMALLWOOD'S OBSERVATORY.

The Observatory at St. Martin, Isle Jesus. A. Thermometer; B. Screen of venetian blinds; C. Thermometer; D. Opening in the roof ridge, closed with shutters, to allow use of transit instrument; E. Rain guage with conducting pipe through the roof; F. Velocity shaft of the anemometer; G. Mast for elevating apparatus for collecting electricity; H. Cord for hoisting the collecting apparatus; I. Direction shaft of the anemometer; J. Copper wire for conducting the electricity into the building.

times daily Dr. Smallwood observed and recorded the amount and type of atmospheric charge, ozone, and other electrical disturbances such as thunderstorms. In keeping with the common practice of the times, he also maintained phenological records of the development of flora and fauna, break-up and freeze-up of rivers and streams. Numerous notes can be found in the record concerning auroras, halos, meteors and other peculiarities of nature no matter how insignificant they may have been.

The observatory was linked by telegraph to many cities in the United States and was part of a voluntary North American observing network. This gave the Doctor the opportunity to observe and examine the scope and extent of atmospheric phenomena, which in turn led to a number of interesting articles. One such, entitled "On the Peculiar Appearance of the Atmosphere on the 23rd., of May 1856 at St. Martins, Isle Jesus, Canada East", was published in the Proceedings of the American Association for the Advancement of Science (AAAS). This paper detailed the events pertaining to forest fires and the smoke pall which spread across the sky. Other articles began appearing in publications such as *Canadian Journal* and the *Canadian Naturalist* as well as detailed abstracts of monthly meteorological summaries from the observatory. An article entitled "On the Cold Term of January 1859" published in the *Canadian Naturalist* provides details concerning a five day period of extreme cold when the temperature remained below -18°C (zero Fahrenheit) and fell as low at times as -42°C (-43.6°F) at St Martins. Another narrative concerning the very heavy snows in Montreal during the winter of 1868-69 contains an interesting reference to the 17th., and 18th., of January 1827 when up to 178 cm (70 inches) of snow fell in the area. Drifts 3.6 to 4.5 m (12 to 15 feet) deep were reported as being commonplace.

Dr. Smallwood's interest in meteorology encompassed a much wider area than just the region in which he lived. His article "On the Distribution of Rain" published in the *Canadian Naturalist* illustrates his knowledge of worldwide rainfall patterns and their causes. When judged by modern science, many of his views and hypotheses as outlined in the articles are scientifically valid, a remarkable achievement considering that meteorology was still in its infancy.

About 1856, the Montreal Natural History Society (which for some time had noticed the dedicated work of Dr. Smallwood) sent a delegation of officials to tour the observatory. The Society members were obviously impressed and arranged for a petition to be sent to Parliament seeking government assistance, not only to finance the observational work, but also to help publish the extensive records. Small grants were forthcoming, but it was to be another fifteen years before an official Canadian interest was taken in meteorology and the work at the observatory. Meanwhile, the

Notman Photographic Archive MPO35/79

McGill Observatory in 1865. It is the small domed structure (second building from the left) in this Montreal view taken towards Mont Royal.

Natural History Society conferred upon Dr. Smallwood the title of honourary member. His name became even better established when he delivered the opening speech at the annual meeting of the AAAS at Montreal in 1857. By 1865, he had become the President of the Natural History Society. Other honours were also given to him, notably the award of an LL.D (Doctor of Laws) degree by McGill University in 1856 where he was also appointed professor of meteorology (but without salary).

In 1863 the observatory was transferred from its original site at St. Martins to a specially built stone structure on the grounds of McGill. After this event, Dr. Smallwood transferred his residence and medical practice to the City of Montreal. Over the years, additions were made to the McGill observatory until finally it was demolished in 1962. Although the structure vanished, meteorological observations are still recorded at the University.

From 1856 when his meteorological accomplishments were first recognized, Dr. Smallwood and others constantly lobbied the Canadian government for funds to support the observatory. However, no money was available to develop his vision of a corps of trained observers throughout the country. Finally, in 1871, the Ministry of Marine and Fisheries established the Meteorological Service of Canada. The observatory was designated as the Montreal station in the network, reporting meteorological observations by telegraph to Toronto for use in the weather forecast office. Dr. Smallwood meanwhile had become an influential member of Montreal's Medical Society. During March, 1871, he was appointed Dean of the recently formed medical facility at Bishop's College. Just two months later however, in late May, he was informed of the government decision to support the observatory and resigned his medical position to direct the meteorological work at McGill. Despite pleas from the medical faculty to reconsider his decision, he was determined to devote his efforts to the goal for which he had so long strived. Tragically, just two years later, on December 22, 1873, Dr. Charles Smallwood died of dropsy.

His accomplishments as a meteorologist are all the more remarkable when it is realized that essentially he was an amateur until late in his life. Even more remarkable is the fact that he was at the same time an illustrious medical practitioner and professor. It is of interest to note that a lengthy obituary in the *Montreal Herald* described in great detail his humanitarian contributions to the citizens of Montreal, but made only a brief reference to his meteorological achievements. Perhaps we can place his life's work in better perspective by realizing that although he was a physician by profession, he was a pioneer meteorologist at heart.

BOOK REVIEW

Highlights of March 1981

- Most of Europe wet
- Heavy rains in parts of East Africa
- Blizzard in Ontario
- Drought relieved in Spain and Portugal
- Dry in Hawaii, wet in Tahiti
- Drought persists in parts of USA
- Cyclones hit Darwin and New Caledonia

More details about these events inside →

JET STREAM edited by Peter B Wright. Westwind Services, Reading, England. Periodical, six issues per year. 32 pages per issue. Minimum postpaid subscription £13.20 annually.

This is a journal jam-packed with information about climatic and weather conditions around the world, and their cause. There are numerical tabulations of average monthly temperature and precipitation values for a number of cities in different countries. Interspersed throughout are charts showing the mean monthly position of jet streams, monthly mean pressure anomalies and sea surface temperature anomalies. Feature articles related to weather and climate are also included. However, this material all together makes a rather heavy lump of climatic dough. Perhaps it will be leavened in time when more contributors give the journal a diverse content and writing style.

Jet Stream suffers badly from lack of organization. It gallops from place to place and back again flinging out pieces of information about water shortages here, closed lows there, thunder or hail and a warm month somewhere else. Temporal relationships are confusing, with articles concerning different time periods jumbled in no apparent order. A much firmer editorial hand is required.

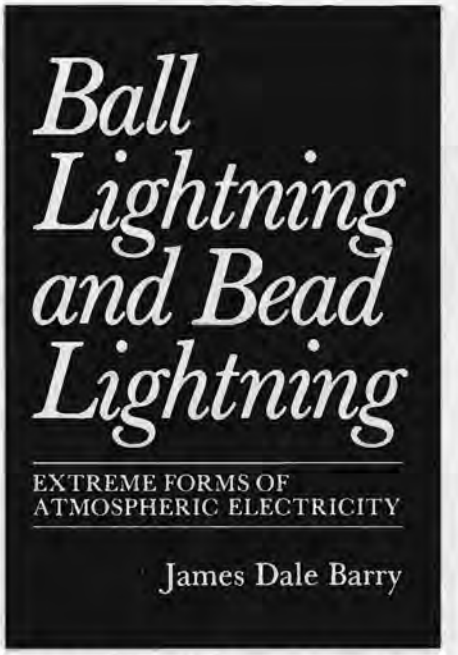
The high cost of doing business in Britain these days is very evident from looking at this publication. It is small in format, has typewriter script text, contains no photographs, has hand-drawn diagrams and yet costs a minimum of £2.20 per issue. You must be a very dedicated weather watcher to purchase and plough through this journal.

CROP YIELDS AND CLIMATE CHANGE TO THE YEAR 2000, Volume I. Drafted by Col. T.H.M. Crampton. National Defence University Report, sponsored by Defense Advanced Research Projects Agency. 1980. Available from U.S. Government Printing Office, Washington, D.C. 20402. Softcover, 119 pages.

This is the report on the second phase of an assessment concerning the impact of global climate change upon crops. Based upon the various types of warming or cooling trends defined by the first assessment phase, it examines which of 9 wheat crops from different countries will be changed in yield, and also what will happen to corn, soybean and rice crops. Large warming or cooling trends, for example, are expected to increase or decrease Canadian spring wheat yields by 8 percent.

The report also examines the effect of technological change and concludes that it, rather than climate, is likely to be the chief determinant of most crop yields in the last quarter of the 20th., century. It is also concerned with the implications of the yield projections upon the Soviet Union's role in the international grain market, and thus indirectly, their behaviour in the political arena.

To properly understand this report, with its many tables and figures, requires a fairly high degree of expertise in the field of statistics. However, the reader who is prepared to forego a rigorous study of what it has to say will still find plenty of interesting material. The information contained in the summary section alone is worth the effort of obtaining this book.



BALL LIGHTNING AND BEAD LIGHTNING by James Dale Barry. Plenum Publishing Corp., New York. 1980. Hardcover, 298 pages. U.S. $29.50.

This exciting book reviews the known physical aspects of ball lightning and bead lightning, two unusual forms of natural atmospheric phenomena. Deducing the characteristics and properties of these luminous events, this work offers an improved general understanding of them.

Intentionally avoiding observational narratives and theoretical models, *Ball Lightning and Bead Lightning* emphasizes the physical aspects of the phenomena. It covers such properties as luminosity, motion, emission characteristics, decay, and environmental effects. The deduced properties of mass density, energy density, temperature, and electromagnetic effects are also examined at length. The volume features detailed descriptions of numerous experimental attempts to duplicate ball lightning and bead lightning in the laboratory or under controlled conditions. These experiments are critically analyzed with respect to their findings and historical significance, and include the use of natural lightning, the use of electric discharges through gaseous media, the use of electric discharges through solid conductors, and the use of radio-frequency discharges. Other highlights of the volume are the inclusion of over fifty photographs, constituting the largest known collection of photographs of these phenomena in one volume, and a bibliography of over 1800 entries.

This book will be of interest to those involved in many branches of geophysical and atmospheric science.

THE IMPORTANCE OF WEATHER SATELLITES, continued.

fog bank over the Pacific, see the pictures in ***Chinook,*** Spring 1979, page 40). The infrared eyes of the satellites "see" variations in the temperature of different surfaces as varying shades of grey. Using special computer enhancing techniques, cloud top temperatures and heights can be determined quite accurately.

Besides these directly observed weather elements, other data fields can be derived indirectly, for example vertical temperature and moisture profiles of the atmosphere can be obtained from TIROS. Cloud top winds can be obtained from GOES once cloud elements and systems are identified, because their direction and speed of motion can be measured and used as tracers of the wind flow. Also, changes such as thunderstorm development and fog dissipation can be monitored, and if all these values and rates of change are moved forward for a short period of time, a short term forecast can be made.

In longer range forecasting (periods longer than 18 hours), such information is combined with meteorological reports from aircraft to infer upper level wind and temperature fields over the Pacific Ocean. This in turn can be used to assess the solutions provided by mathematical computer models of expected atmospheric behaviour. It is hoped that satellite data can be placed in the computer that will in effect "tell" the mathematical model where it has gone wrong, and help it to try again.

The imagery transmitted by satellites has so far taught many lessons concerning the real behaviour of weather systems that could never be learned in any other way, but early claims that the new technology would provide immediate and substantial forecast improvements proved to be premature. The full potential of satellites can only be realized when they are integrated into computer systems that can simultaneously handle not only the huge quantities of daily data received from space, but also that from radar and other remote sensing systems. It is important that what we interpret from space is actually what is being reported as happening at the earth's surface or in the atmosphere below the cloud tops. This era is only just beginning.

At the Pacific Weather Centre, weather satellites are already yielding invaluable information concerning which mountain passes are obscured by clouds, and which rapidly developing storms over the Pacific threaten B.C. with flooding downpours etc. But in future years, improvements in matching computer and satellite technology promises to make an even more important contribution to weather forecasting in Canada.

ARCH PUZZLE by Bob Stark

#18 QUIZ ON CHINOOK

How much of what you read do you remember? Since this issue closes out another volume of ***Chinook*** it is an appropriate place to run a memory testing quiz. See how many of the following questions you can answer *(we don't mind if you cheat a little because I had to, Ed).*

(a) What Ontario location recorded -73°F on June 23, 1935 and what company did meteorologist Leon Kent work for?
(b) When, what sloop, and how many men first sailed through the Northwest Passage?
(c) On October 11, 1979 what meteorological event happened in Wellington, New Zealand?
(d) Name the goddess of the sea and a type of home-made Newfoundland anchor, and give their meteorological significance.
(e) What do these instruments measure or display; AQM-S2, Maestro, Taylor 3100, Munro R100, Comprop, WAD 13?
(f) What is the "Topside Sounder"?
(g) If business continues as usual, what will double by 2035?
(h) According to the Bad Töltzer weather phase model, what condition increases the incidence of angina by 5 to 10% above expectations?
(i) What insects make a cold front visible?
(j) Name the author who wrote concerning the toll of the Woodstock tornado of August 7, 1979.
(k) Où est 20% de la population canadienne?
(l) How many of the 79 tornadoes in Canada during 1980 reached the F2 category?
(m) How high is INCO's stack?
(n) Whose Lifeboat is meant to introduce students to human ecology?
(o) Why was Percy sorry for the donkey riders in Saskatchewan?
(p) During the early 1800's what action and which department conceived the United States Weather Bureau?

continued on page 6

Honest, Baroque is gonna be real big this season....

ARCH PUZZLE, continued

(q) Give three factors that reduce fuel consumption in heating homes.
(r) Who designed the Meewasin Valley Project?
(s) Fanning, fumigation, looping and lofting are types of what?

The answers to all these questions can be found in the last few issues of ***Chinook***, but for those who do not wish to take the time to look, we will print the answers in the next issue.

RESPONSES TO ARCH PUZZLE #17

An invitation for graffito is bound to bring a variety of responses, some of which, although entertaining, can't be printed.

Moving on the the printable variety, the responses can be placed in several different categories. Predictably, some used puns related to the expression "rain cats and dogs", for example **C. Vernon** of Toronto, Ontario sent the following: "She: There's just been an accident between two Japanese cars. He: Yes, I know. Its raining Datsun cogs". **Donald Fraser** of Nepean, Ontario sent a number of irreverent captions, one of which capitalized on the juxtaposition of the woman's hand and the umbrella, "I'll have you know dear, that a fist is no match for a lethal umbrella". Others, such as **Steve LaDochy,** Winnipeg, Manitoba, utilized the idea that the umbrella is necessary to protect the husband from the wife. His entry was "No offence dear, but when you talk fast without your dentures, I might as well be at Niagara Falls". The same theme was used by **H.H. Watson** of Nepean, Ontario, a regular follower of this column who sent his graffito caption in the form of a scrambleword as follows: "---- --- -----?" To discover his caption, unscramble the clues which follow and then re-arrange the letters in the circles to form the three words.

EEEZRB TUGHORD
- - - O O O - - O O - - -
YUSNN TIMS WDE
O O O - O O - O O - O -

Answer: *"Must you sneeze?"*

However, the response judged to be the best was sent by **Irene Heltner** of Waterford, Ontario whose caption was as follows:

"Rain drops keep fallin' on my head
And just like the guy whose feet
Are too big for his bed..."
(from the song by B.J. Thomas).

She is the recipient of the winner's prize, a book entitled "White Death, Blizzard of '77" by Erno Rossi. Our thanks to all who sent in entries.

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TRADE WINDS Edited by Claude Labine

Photo left. Brian Cornwall, Vice President, Airflow Developments. Photo right. Tony Horabin at the open jet wind tunnel.

CHINOOK VISITS AIRFLOW DEVELOPMENTS by Scott Somerville

As part of a continuing review of meteorological companies in Canada, ***Chinook*** recently visited **Airflow Developments,** a supplier of meteorological instruments. **Airflow's** affable Vice President, **Brian Cornwall,** took us on a tour of his new plant in Mississauga, Ontario, which is crammed to the gunnels with everything from wind-sock frames ("hard to get" commented Mr. Cornwall, "especially the kind with corrosion resistant bronze hinges") to electronic measuring devices.

Established twenty years ago, the company was committed primarily to the sale of anemometers but quickly diversified into other kinds of meteorological instruments as customer enquiries proliferated. Mr. Cornwall explained that recent interest in air pollution and the energy field has increased the requirement for instrumentation and has given **Airflow** the business success that it presently enjoys. In one way or another, all the instruments sold by the company relate to the measurement of atmospheric properties such as heat, pressure, wind velocity, pollution, and solar radiation. Approximately six hundred instruments are listed in the company catalogue and include items such as sunshine recorders, devices for measuring the potential for wind power (to find out how much energy a windmill will generate at a given time and place), and radioactive radiation samplers.

Anemometers of various types still make up an important section of the catalogue and **Airflow** operates an open jet wind tunnel to calibrate the smaller vane types. The machine is about 4.6 metres long and delivers a free air stream 15 cm in diameter at speeds ranging from 0.1 to 34 metres/sec. As we walked over to examine it, Mr. Cornwall explained that his customers range from those who place large orders for an entire string of weather stations to school children who may want instruments for their class projects. one such customer is a school boy who has been buying instruments over a period of seven or eight years as he can afford them, and who has now built up a fine home weather station that rivals the capability of some official weather reporting sites.

"There's no room in this business", said Mr. Cornwall, "for the pre-packaged, self-serve supermarket style of business". Instead, **Airflow** is very traditional in believing that there must be room in their profit for personalized service. To provide this, company employees are initially trained on the job as instrument mechanics which permits them to become familiar with the various products. When they receive promotions to managerial or sales positions, they are then in a position to materially aid a customer in making the best selection for the specific purpose.

Asked about the role that the company plays in the meteorological community, Mr. Cornwall answered "it is to supply either the best instrument that is available, or else the best available instrument for the price."

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VOLUME THREE INDEX

A list of authors, articles and advertisers in Chinook, Volume 3, numbers 1 to 4. An asterisk (*) indicates a column which appears regularly. If the authorship of an article is not shown, it is by the Editor.

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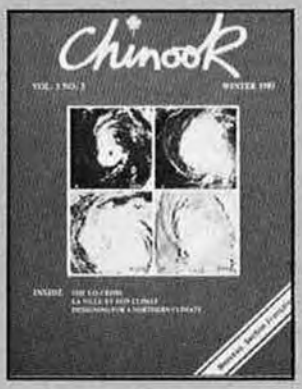

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