Chinook

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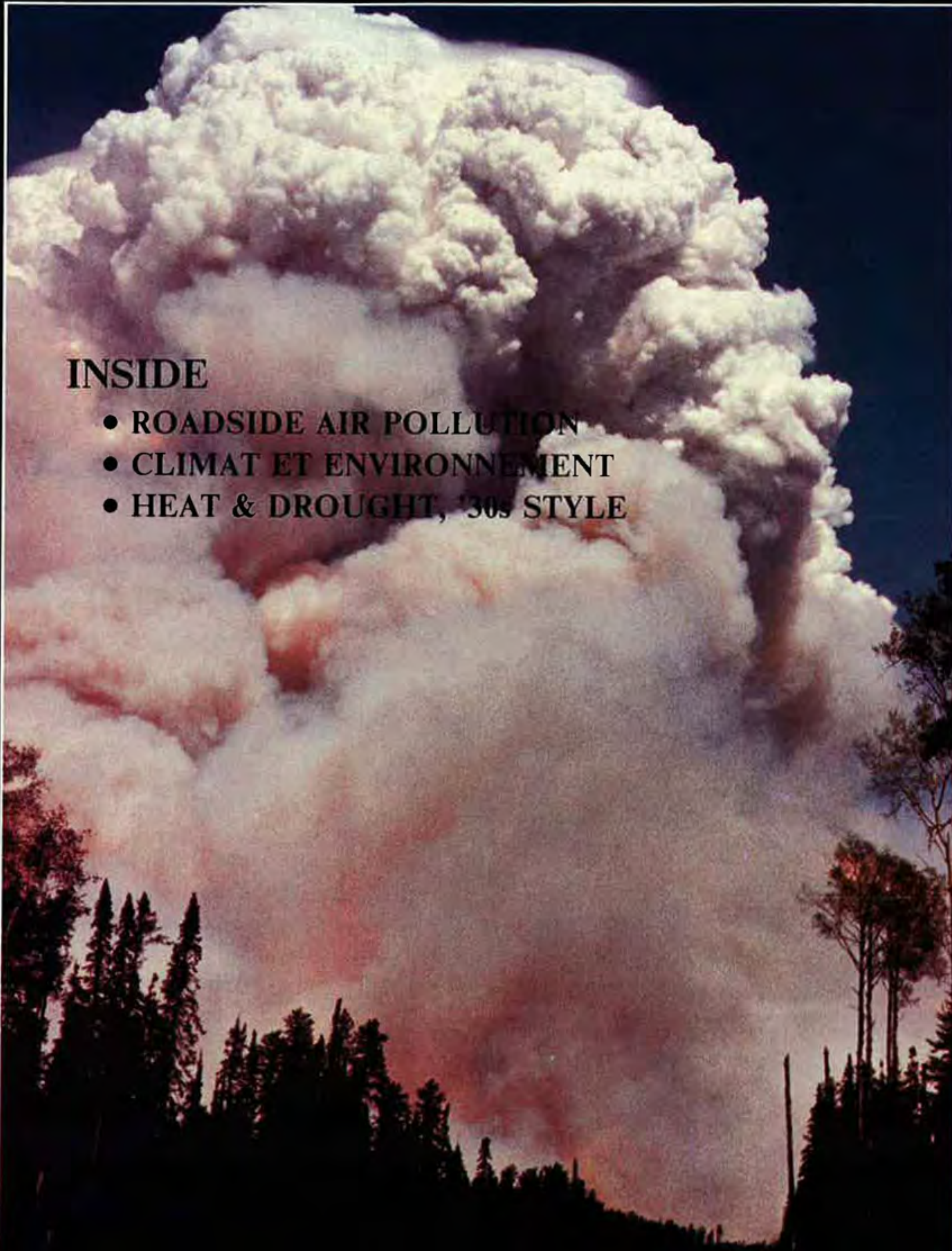

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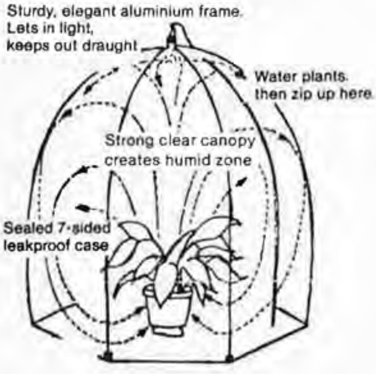

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Articles

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THE COVER

The photograph on the cover shows a pyrocumulus cloud and was taken near Sioux Lookout, Ontario by **Garney Baverstock**, Ontario Ministry of Natural Resources. Although similar in appearance to other cumulus clouds, the pyrocumulus is to be found only over fires such as forest fires, or agricultural fires. Its moisture source is the vapour released from the burning forest or vegetation below. Pyrocumulus clouds have been known to produce very heavy rainfalls, but most often downwind from the fire where it is of little benefit to the firefighters. One of the best known examples of these artificially caused clouds formed over the immense heat of burning Tokyo in 1923. The city had been devastated by an earthquake, followed by an immense fire. The towering pyrocumulus cloud which then formed, actually produced its own destructive tornadoes.

MODELLING OF CO_2 NOT TRUE TO NATURE — AUTHOR'S REPLY

Your reader, W.L. Pugsley, has raised an important point (***Chinook***, Spring 1981) that deserves some explanation but which was beyond the scope of my article "The CO_2 Crisis". At present, experts agree that the climate of the earth is in the initial stages of a cooling period after a prolonged warmer period that started about 1850 and reached a maximum about 1950. These trends can be determined by taking a weighted average of the annual mean temperature determined at a number of weather stations in the northern hemisphere, or from the number of frost free days recorded at stations (particularly in pioneer agriculture areas) near 60° latitude. The noise (annual fluctuations or weather) in this mean hemispheric temperature is about $\pm$ 0.5. Consequently, it may take another 25 years before we are able to confirm the predictions discussed in my article since the warming effect of the CO_2 must be superimposed on the cooling trend. It is my contention that prudent behaviour dictates that we should be altering our global and national energy policies in such a way as to minimize the irreversible climate threat constituted by the present atmospheric CO_2 concentration trends, since this is the one experiment that we should avoid making.

It is important to remember that the time scale to implement a national energy strategy that takes account of the CO_2 effect is of the order of 25 years. There is no disagreement about the basic validity of the predictions although the details may be in doubt. The U.S. government had the wisdom to ban the use of the halofluorides as spray can propellants because of the potential adverse health effects to humans of an increased intensity of ultraviolet radiation at the earth's surface (skin cancer). The same wisdom is now required concerning the CO_2 crisis. your other reader, Don L. Gary, will be interested in the article **Carbon Dioxide Warming and Coastline Flooding: Physical Factors and Climate Impact** by S.H. Schneider and R.J. Chan in *Annual Review of Energy 5*, 107,—140 (1980).

H.A. Buckmaster
The University of Calgary, Alberta.

ROADSIDE AIR POLLUTION

by Y.S. Chung

A naturalist's life would be a happy one if he had only to observe and never to write.

— *Charles Darwin*

Recent developments of air-pollution research have been focused on the atmospheric transport and diffusion of man made pollutants. Many scientists also have become concerned with the effects of airborne pollutants on sensitive species of vegetation. For example, it has been found that some forests of eastern white pine in the Sudbury, Ontario area have been severely injured by sulphur dioxide (SO_2), and it has been estimated that the economic losses to the white bean crop due to ozone (O_3) pollution is about 10-15% each year ($ 3-4 million annually) in southern Ontario.

It is considered that medium (10-100 km) and long range (100-1000 km) transport of nitrogen oxides (NOx), SO_2 and hydrocarbons downwind of source regions is responsible for high concentrations of ambient ozone and sulphate observed in southern Ontario. On a smaller scale (approximately 1 km) it has been observed that many varieties of coniferous trees (mainly eastern white and red pine, spruce, cedar, juniper) growing close to major highways show visible signs of severe injury. Pine trees in particular have been found to be highly sensitive to air pollution.

In Ontario, winter snowfalls often create serious problems for motorists. Snow removal includes the use of extensive amounts of rock salt on most Ontario highways. The frequent use of salt, often mixed with sand, is known to be effective for melting snow on roadways in air temperatures down to about minus 10° C. This salt has a NaCl content of 97.7 ± 1.5% plus other chemials such as $CaSO_4$ (1.5%), $CaCO_3$, $MgCO_3$, and $MgCl_2$ and a few insoluble substances. In Toronto (population 2.5 million), on the average 55,000 metric tons per year ($ 1.2 million) of rock salt is used. An average of 7300 metric tons per year ($ 161,000) or 110 metric tons per km, is used on Hwy. 400 where daily traffic volume in winter ranges from 17,075-43,050 vehicles between the junctions with Hwy 9 in the north, and the junction with Finch Avenue (Toronto) in

FIGURE 1. A map of the study region.

the south. The volume is reduced markedly toward Barrie. Traffic movement produces major quantities of fine salt particles which, when airborne, are transported various distances from the highways by prevailing winds at low levels.

Variable amounts of snow are received in southern Ontario depending on local topography. For instance, in the lee of Nottawasaga Bay (off Georgian Bay) there is a snowbelt area arising from lake effects and orographic lifting of the moist air in the lower atmosphere. Observed frequencies and amounts of snowfall increase from Toronto to Barrie. In particular, the frequency of snowfall in the Barrie area is approximately one and a half times higher than that recorded at Beeton and Toronto International Airport. Hwy 89, which intersects Hwy 400 about 20 km south of Barrie, is approximately the southern boundary of this snow belt region. During the cold winter of 1976-77, the frequency of snowfall increased quite considerably. As a result salt usage for snow removal was heavier than average and pine tree damage along major highways was rather striking the following spring.

At various times, a considerable amount of criticism and publicity has been directed at the impact of the extensive use of de-icing salt in Canada. Consequently, it was decided to conduct an impact study of the situation in order to observe some of the remarkable features of the tree damage and to discover some of the meteorological and non-meterological factors involved in acute needle injury. It is evident that selected studies of these effects will add to our knowledge, especially concerning the mechanisms of airborne transport of pollutants which are generated on highways.

Data on tree damage was collected from a dozen major highways in Ontario (see Figure 1 for a map of the study region) during routine weekly observations in 1975-76 and 1976-77. Particular attention was paid to the six lanes of Highway 400 stretching 66 km northwards from Toronto to Barrie. In total, about 200 groups of coniferous trees (10 or more trees in a group) were observed. This systematic search revealed that injury due to air pollution was apparent on white and red pine. The principal pollutants causing the damage appeared to include a mixture of salt and automobile exhausts (NOx, hydrocarbons etc.).

Acute needle injury of pine trees was most obvious near major highways (usually within 100 m) from late February to June. Observable tree injury was evident throughout much of southern Ontario and extended up to and included the Muskoka and Haliburton regions. Visible symptoms of injury involved needle browning (or 'needle blight', 'chlorotic mottle' and 'tip necrosis'), a type of damage usually experienced by plants under drought conditions. Typical symptoms in their various stages of needle injury are illustrated in Fig. 2.

Symptoms of chemical injuries are much different than those of normal winter kill. Initially, in the chemical case, slightly damaged needles appeared dark grey-green during January with the greenish colour changing to red (or orange-brown), normally beginning at the needle tips, as the injury became visibly noticeable (late February). In some cases, the onset of injury started in the middle parts of the needles. The outbreaks of needle browning coincided with the sudden warming in air temperature during early March, while the maximum intensity of colour, orange-brown, occurred in mid- to late April. Injured brown needles dropped from trees by the end of June, and in June new needles started to bud. This needle browning of pine trees has also been associated with ozone and sulphur dioxide injuries in the Sudbury area. Tree growth, however, was noticeably suppressed by the Sudbury smoke plume with many dead branches and trees.

The severity of needle injury varied markedly with location. In the first case this was due to pollutants carried downwind by the prevailing westerly flow of air. For instance, there was more evidence of damage to conifers on the east side of a highway (N-S oriented) than on the west side. In general, needle injury to a pine tree facing west and south, on the east side of the highway, was much more pronounced. On the other hand, injury was less significant on the side of the tree facing north and east. In the second case, the degree of tree damage was also seen to depend on topographical features such as hilly or open land. Symptoms of needle browning were observed along the highways usually within 100 m, however, in some cases evidence of tree damage was noticeable up to distances of about 500 m along the east side. In sections where the trees were densely planted, damage did not occur beyond about 50 m.

Plant damage due to de-icing salt has been discussed in the botanical sciences since the early 1960's. Earlier investigations have shown the effects of salt damage to trees resulting from winter de-icing activities along highways, and similar damage resulting from sea-salt sprays has also been the subject of scientific scrutiny. Furthermore, it has been shown that excess salt in soil also produces some damage to trees.

In this study, symptoms of needle browning and twig dieback along the Hwy 400 were more noticeable for pine trees north of Hwy 89. Damage in the Barrie District was more severe than that observed near Toronto. As noted earlier, the amount and frequency of snowfall increased, and salt usage was heavier particularly near the Barrie region. This suggests that airborne salt particles could be a major cause of the acute tree injury observed along highways.

For the winter months (November-March), the prevailing winds in the Toronto region are generally westnorth-westerly averaging 17.6 km/h. Thus, a large amount of airborne salt, generated by highway traffice, was transported eastward by the winds over distances of 0.5 km and deposited on the ground and trees. Previous investigators have noted that injured trees were covered with large amounts of salt. They attributed the observed damage to the effects of these substances in conjunction with the prevailing winds, and have postulated that NaCl reduces cold hardiness in trees, with a corresponding increase in twig and branch dieback.

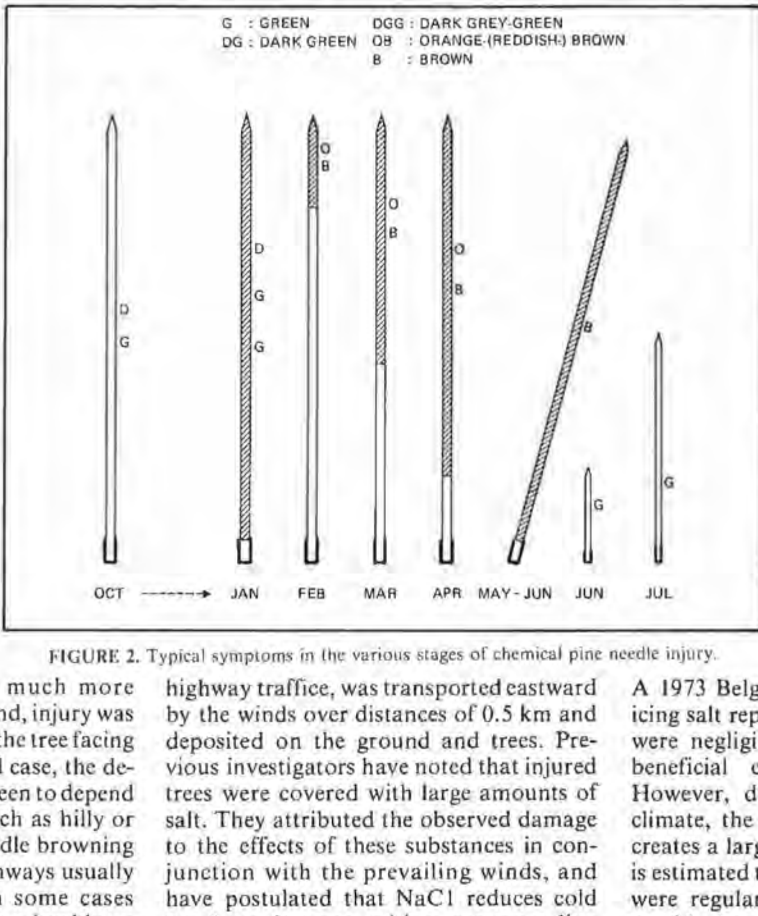


FIGURE 2. Typical symptoms in the various stages of chemical pine needle injury.

The accumulated effects of automobile exhausts over several years may also be instrumental in causing roadside tree damage. For example, it is well known that NOx alone can cause tree damage. With sunlight, a mixture of air pollutants, such as NaCl, NOx, CO, SO_4 and hydrocarbons, might form other toxic substances such as $NaSO_4$, $CaCl_2$, $NaHCO_3$, NaOH, HCl, $ClNH_4$, etc. In this regard, it has been postulated that chloramine (tear gas) could be formed from the reaction of the chloride ions arising from sea salt spray with amine and ammonia radicals. With needle stomata open during the daytime, a considerable amount of such toxicants can be taken in by the processes of photosynthesis. In any event, the mixing of Na and Cl with automobile emissions might lead to the formation of more toxic compounds resulting in pronounced damage to plant chlorophyll during daylight hours.

In Ontario, solar radiation arriving at the earth's surface increases considerably in late February and March. The intensity of solar radiation is generally higher during the afternoon hours especially on surfaces facing south and southwest. Interestingly, the degree of acute injuries downwind was more severe for needles facing these directions, which perhaps indicates that insolation is important in photosynthesis in the spring warm-up and subsequent needle damage. Air pollutants are known to destroy plant chlorophylls which ultimately disrupts plant photosynthetic activity and suppresses growth.

An obvious pollution control strategy suggested by this study is to plant dense stands of coniferous and deciduous trees along the highways to screen against the distant transport of air pollutants. Perhaps greater use could be made of spruce trees for this purpose because they were found to be somewhat more damage resistant.

A 1973 Belgian study of the effect of de-icing salt reported that pollution problems were negligible when compared with the beneficial effects upon traffic safety. However, due to the harsher Canadian climate, the greater use of rock salt here creates a larger problem than in Europe. It is estimated that if the severely injured trees were regularly replaced, the annual cost would be several million dollars. A disturbing question which is left open by the study concerns the effect of the pollutants upon humans and animals living close to highways. Only detailed biometeorological research will provide the answer concerning possible hazards to roadside inhabitants due to airborne salt pollution and automobile exhausts.

Dr. Y.S. Chung is an Environment Canada research scientist.

A SALUTE TO THE WEATHER AMATEUR

"I may be almost 96 years old, but must people keep rubbing it in?" Winifred Hoad's question was asked over an afternoon sherry in the living room of her quiet home in Uxbridge, Ontario. Around us were the mementos and awards from her thirty years as a volunteer weather observer for the Canadian weather service. "The doctor says the sherry isn't good for me" she admitted, but like the protestation concerning her age, I think that this was actually a declaration of her independence, and a modest boast about her vitality and longevity. "Actually" she continued, "my hope was to continue indefinitely as a weather observer, but three years ago, in 1978, arthritis forced me to relinquish my duties".

These duties began in 1948 just after Miss Hoad had retired from many years of service as an executive secretary at the Sun Life Insurance Company in Montreal. After she moved to Uxbridge, friends regularly sent her the *Montreal Herald* newspaper where she saw an article by the Meteorological Service of Canada requesting volunteer observers. Although she knew nothing about observing, she had been generally interested in the weather all her life and so signed up. Measuring instruments were placed in her garden, she was shown how to use them and began the first of her daily reports. In the beginning these consisted of only rainfall and snow-depth measurements because the Uxbridge CN Station Agent, a Mr. St. John, already represented the area with his temperature observations, but upon his retirement she took over. Rain or shine, snow or blow, for the next thirty years Miss Hoad made twice daily trips to the instrument shelter to record the actual temperature, the minimum and maximum values for the climatological day, as well as the amount of rain or snow. At the end of each month she abstracted her records onto a report to be mailed to the Toronto head office of the Meteorological Service.

For this faithfulness she was presented with several awards. In preparation for my visit they were placed within reach, and with obvious pride she showed me the first award, a beautifully illustrated book "Images of Canada" published by the Canadian Geographical Society and presented to her in 1955 for outstanding service. This was followed by a wall barometer in 1968 which was awarded for merit, and finally in 1978 upon her retirement, a Certificate of Achievement and an inscribed tray for dedicated service. At hand too, was a copy of the local weekly *Uxbridge Journal* for June 21, 1978 which featured a front page photograph of Miss Hoad at her backyard weather station receiving her retirement awards. Taking my arm, she made another trip to the station for a portrait photograph. As we approached the now empty instrument shelter, she allowed as how she missed the work terribly, "it became a part of my life" she commented as she fussed with her hair.

Timothy Lethbridge is at the other end of the age spectrum and lives half a country away, but he is also a weather amateur. I met this enthusiastic 17 year old student from Bathurst High School, New Brunswick at the 20th., Annual Canada-Wide Science Fair which was held this year at the University of Waterloo, in Kitchener, Ontario. Exhibitors are given only a small amount of space for their display, but Timothy had very ingeniously expanded upon it by equipping his booth with several screens which could be pulled down from spring-loaded rollers. These, as well as the main walls of his display were loaded with information from his home weather station in an exhibit entitled "Bathurst N.B. Weather — Past, Present, Future", and represented the fruits of several years of dedicated weather observing. Despite a disconcerting tendency for the screens to snap upwards from time to time, Timothy could not be distracted from an energetic explanation of his work.

Beginning in 1977 he began collecting a wide range of data utilizing many different measuring instruments, some of which he built himself. From his yearly records he has calculated averages which do a very creditable job of describing the climate of his area. For example, he has analyzed annual temperature trends, calculated the prevailing wind direction, average snow and rainfall as well as the number of days with frost, the number of growth days and other statistics. Furthermore he has designed an analogue system of making a weather forecast for a particular location from a set of basic predictors, namely the wind direction, the barometric tendency and the cloud type. Checking back over his records, he listed the outcome of various combinations of the predictors. As an example, he found for instance that the most likely result of a combination of cumulus clouds, a rising barometer and northwest winds was good weather, while the same conditions but with an easterly wind meant a change for the worse fairly soon. By condensing all of this into a convenient chart, he has developed a system that he claims will give a correct generalized forecast for his location 75% of the time.

Chinook salutes these two weather amateurs and the many others like them. Young or old, each in their own way exemplify the spirit which motivates mankind's innate struggle to understand the surrounding environment.

CLIMAT ET ENVIRONNEMENT

par Richard Leduc
Environnement-Québec

La météorologie et la climatologie, branches de la physique, sont d'abord et avant tout de véritables sciences environnementales. L'homme vit et évolue dans un environnement atmosphérique qui lui procure à la fois l'air qu'il a besoin pour respirer ainsi que le soleil et la pluie essentiels à la vie; tantôt celui-ci profite du climat, tantôt il en subit les colères. La météorologie et la climatologie ont donc pour but de mieux comprendre, à la fois, l'atmosphère, ses manifestations ainsi que leurs relations avec l'homme et son milieu, dans un but descriptif ou prédictif. Pour d'autres sciences, les préoccupations environnementales sont relativement nouvelles ou ne constituent qu'une facette de leurs activités: pour l'hydrologie, par exemple, ce sont les inondations suite à un événement métorologique; la chimie, de par sa puissance à manipuler et à façonner la matière, doit maintenant se préoccuper des conséquences de l'injection dans la chaîne alimentaire de substances potentiellement néfastes.

Tentons de décrire ce que l'on entend par environnement. Pour plusieurs le concept d'environnement prend une signification très restreinte: espaces verts ou faune et flore locale. En son sens le plus large, l'environnement englobe toute la surface de la planète et s'étend des profondeurs souterraines où reposent les nappes phréatiques jusqu'à la stratosphère, là où réside la couche d'ozone; en météorologie et climatologie, on s'intéresse à ce qui se passe sur l'étendue de la planète, de sa surface jusqu'aux confins de l'atmosphère. Notons en passant que la conscience environnementale se développe suivant l'importance que l'on accorde à une perturbation donnée; ainsi peu de personnes ne connaissait l'existence de la couche d'ozone (et de ses effets) avant que ne soit amené sur place publique le débat sur les cannettes aérosols.

La météorologie et la climatologie s'intéressent à l'atmosphère sous des aspects qui la considèrent à la fois comme ressource et comme nuisance. Ainsi, l'ecoulement de l'air peut-être considéré comme une nuisance si ce dernier est chargé de pollution mais est essentiel au processus de dilution et dipersion des polluants atmosphériques; de la même façon, une tempête de neige sournoise pertube énormément une zone urbaine (augmentation de dépenses) mais elle est nécessaire aux centres de ski (emplois, économie régionale) ou un pluie trop abondante peut causé une inondation soudaine (érosion du sol, glissement de terrain) mais elle est essentielle à la reconstitution des réserves d'eau (eau potable, agriculture).

Quelles sont les composantes environnementales auxquelles s'intéressent la météorologie et la climatologie? Tout d'abord il y a la température (régime thermique), la précipitation et ses qualités, le vent, l'humidité, le rayonnement, les phénomènes extrêmes, etc. La combinaison, en un moment donné, de tous ces éléments constitue l'environnement atmosphérique et représente un stress dont l'intensité et la durée varient selon la sensibilité du système qui le subit.

Avant de passer à des exemples, quelques mots sur les données: la météorologie et la climatologie sont très exigentes à ce point de vue. Pour obtenir une bonne représentation spatiale, il faut de nombreuses stations qui opèrent sur une assez longue période et les changements de sites et d'appareils font la hantise des climatologistes. Mais pour pallier à ce côté exigeant, la prévision, les applications et la recherche se contentent souvent de la même observation et ainsi différentes combinaisons de données peuvent résoudre des problèmes très variés (en pollution de l'air et en énergie solaire, par exemple).

On a déjà discuté de quelques caractéristiques du climat urbain dans ces pages. Etant donné l'importance de ce sujet, insistons sur ses grandes lignes. Une partie sans cesse croissante de la population vivra dans les villes, le sol agricol étant devenu une richesse inestimable que l'on doit conserver à tout prix. La ville, de par sa confection même, altère le climat d'une façon radicale: les surfaces asphaltées, les édifices et les canyons urbains engendrent des régimes d'absorption et d'émission d'énergie qui leurs sont très particuliers. Les villes modifient considérablement les échanges de chaleur sensible et latente et d'énormes quantités de polluants et de chaleur viennent s'ajouter à l'atmosphère urbain. L'écoulement de l'air est perturbé, souvent réduit mais parfois, localement, dangereusement accéléré. Tout ceci se traduit finalement par un stress: des zones d'inconfort et potentiellement dangereuses apparaissent et en certaines circonstances, les mécanismes assurant une relativement bonne dilution des polluants, sont modifiés (mentionnons que les facteurs géographiques et topographiques locaux jouent aussi un rôle important). Le déversement accidentel de substances toxiques gazeuses en milieu populeux montre à quel point, il est nécessaire de prévoir le vent sur une petite échelle. L'homo urbainis est-il condamné à périr étouffé? Heureusement qu'il a transplanté à la ville une partie de son environnement rural; les espaces verts ont une importance primordiale et une étude effectuée à Québec montre comment les parcs peuvent servir de source d'air frais; à ce titre, les études sur le comportement de la forêt urbaine n'en sont qu'à leur début.

On entend de plus en plus parler des effets néfastes des sautes d'humeur du climat et notre société y est beaucoup plus sensible qu'on ne veut le croire. Un dégel hivernal comme celui de février 1981 a des profondes conséquences économiques; il faudra des années avant que les producteurs de sud-ouest ontarien ou que les pommiculteurs du Québec s'en remettent; le tout signifiant des prix supérieurs aux consommateurs. Les fortes pluies (par exemple dans la région de Montmagny en août 1981) ou les tornades et orages violents (Windsor, 1979) causent des dommages matériels très élevés ($100 millions/an aux Etats-Unis). De même les périodes de sécheresse prolongées ont un impact direct sur l'approvisionnement en eau potable et sur le rendement agricole (une diminution de 20% de la précipitation durant les mois de croissance du blé aux Etats-Unis entraînerait une perte nette de $139 millions, selon un climatologiste américan. Les pluies acides sont un autre désastre environnemental; Masse a donné un aperçu de ce problème.

Abordons l'exemple de la biométéorologie (humaine). L'homme est un système très complexe et il possède une faculté d'adaptation remarquable. Les relations climat-santé ne sont parfois pas très directes ni évidentes et, par exemple: dire quelle est la proportion sans cesse grandissante, du coût total des maladies respiratoires ($5 milliards/an aux É.U.) dues à la pollution de l'air, est très difficile. Existe-t-il vraiment des liens entre le temps qu'il fait et les maladies comme les rhumatismes, l'asthme, les allergies, les maladies coronariennes (même la morbidité) et autres? Les personnes qui en souffrent, parviendraient sûrement à en convaincre plus d'un et des études très sérieuses en Hollande ont montré que tel était le cas. Il est bien connu qu'une période prolongée de stagnation peut causer des ennuis aux personnes affectées de troubles respiratoires (à Québec à l'automne 1979) et augmenter au-delà de niveaux acceptables, les concentrations de polluants. Dans une société où les coûts de santé sont extrêmentment élevés, il semblerait utile de s'attarder à ces problèmes.

Terminons par quelques mots sur le design environnemental. Les données climatiques peuvent être employées dans un concept d'intégration de l'habitation à son environnement climatique dans le but d'économiser de l'énergie; la maison solaire passive en est le résultat. De la même façon, une série de décisions prise à la lumière des données climatiques peuvent influer sur un schéma d'aménagement urbain (ou de quartier) que ce soit pour la localisation d'industries polluantes ou pour la protection contre des événements extrêmes. La mosaïque urbaine peut aussi être façonnée de telle sorte que les parcs et espaces verts, en plus de remplir une fonction esthétique et de repos, puissent fournir de l'air frais, tout en filtrant le bruit et les polluants. Les données climatiques, ou leurs dérivés, sont aussi utilisées dans une foule d'autres domaines comme le transport, le génie, la construction, le tourisme, les énergies nouvelles, etc. La fréquence d'utilisation des données climatiques sera d'autant plus élevée que l'on réalisera qu'il est rentable de le faire.

Les quelques exemples que nous avons présentés, montrent bien que la météorologie et la climatologie sont des sciences environnementales globales. De plus, le climat est tout autant une ressource nationale qu'un agent imposant de fortes contraintes et d'énormes stress, dont la société doit subir les conséquences .

LES PYROCUMULUS

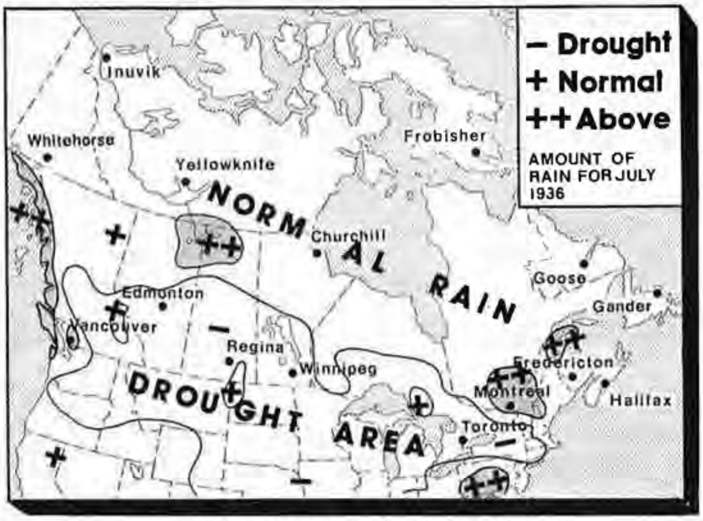
par Peter Chen

Dans les basses couches atmosphériques, les nuages à caractère convectif appelés cumulus, se forment quand de l'air chaud et humide se soulève jusqu'à saturation. L'on sait que le soulèvement de l'air peut être contrôlé par des mécanismes physiques différents soit: le réchauffement de l'air près du sol par le soleil, le passage d'un feu de forêt, l'air chaud's s'échappant chaud ou par ascension orographique forcée en terrain montagneux. Dans le cas d'un feu de forêt, l'air chaud s'échappant de de ce dernier, fournit le processus de soulèvement alors que la combustion des arbres produit l'humidité: par conséquent, il est donc possible d'assiter à la formation de pyrocumulus, même en présence d'air stable et sèche.

Sur les photos ci-jointes, prises au Wyoming à l'été 1980, on peut observer la formation et le développement de cumulus par une journée pourtant claire et sans nuage. Au tout début, l'on a aperçu de petits panaches de fumée grise qui sont apparus au loin au delà des montagnes. La photo du haut a été prise environ 20 minutes après que le premier nuage fut observé. Le nuage à la droite de la photo graphie, avait originalement apparu là où le petit nuage en formation au-dessus de la colonne de fumée se trouve.

La photo du bas, prise de 45 minutes à 1 heure plus tard, nous montre qu'un cumulus bien développé s'est établi au dessus du feu de forêt.

Quand les conditions sont favorables, ces cumulus se transforment en cumulonimbus; on a alors l'établissement d'un cycle. Au début, le feu de forêt fournit les éléments nécessaires à la formation de nuages convectifs qui se développent jusqu'à obtenir des cumulo-nimbus. Ces derniers produisent des rafales de vent, des éclairs et des précipitations qui influencent à leur tour l'évolution du feu de forêt.



The drought area at its height in July 1936.

HEAT AND DROUGHT, 1930's STYLE

by Scott Somerville

Even at the best of times the climate of the Canadian prairies can only be described as semi-arid. With as little as 250 mm of precipitation annually, the area receives about a third of the moisture that is bestowed upon southern Ontario. Any prairie departure from normal, particularly during the sensitive period of May and June when the developing grasses, including grain, are in greatest need of rain, causes concern to the western farmer. It is only the capacity of the clay soils to hold moisture, coupled with the deep-seeking roots of the grasses which helps the plants survive through the dry mid-summer season.

Earlier this year, during the Spring and early Summer, fears were aroused in the west of a repeat of the so called "Dirty Thirties". Very dry weather and strong searing winds swept dust across the prairie provinces and parts of the adjacent U.S., reducing visibility, choking drainage ditches and raising the spectre of stunted crops withering in a land bereft of its top soil. Dust devils, whirling across the fields, were a more common sight than usual. Although nature sorted the situation out and balanced the moisture supply, the abnormally dry Spring of 1981 was the third in a row, following the very dry Spring seasons of 1979 and 1980. It was natural that comparisons would be made with the dry 1930's, a period well remembered by those who were forced to contend with the problems imposed by the climate. The depletion of top-soil by the desert-like winds, with dust drifts half way up telephone poles; the attendant plagues of Russian thistle and grasshoppers — who could forget. But the prairies were not the only target. Expanding northwards and then eastwards, the drought and heat also extended from its birthplace in the Dust Bowl of the southwestern states to most of Ontario as well as the plains.

Looking back, the reputation of the 1930's decade as a drought period can be attributed mainly to the two year combination of 1936 and 1937. Although some of the other years of the period were dry, a few actually were wet at various localities across the prairies. Of the two years, the year 1936 witnessed the hottest and most prolonged period of intense heat, combined with the lack of widespread substantial rain. This period of most destructive heat and drought lasted for approximately two weeks during July and primarily encompassed the southern portions of Saskatchewan and Manitoba, most of Ontario as well as a substantial portion of the central and northern United States. It began on Saturday July 4th., when hot dry air, originating from the deserts of the southwest, was pumped northeastwards by a large high pressure area centred over Georgia. By the next day, July 5th., the hot air had infiltrated the prairies pushing temperatures as high as 41.1°C at both St. Albans, Manitoba and Yellow Grass, Saskatchewan. The highest reading was 43.9°C at Midale, Saskatchewan. It was exactly one year later to the day, however, that both Midale and Yellow Grass were to enter the record books as Canada's hottest ever locations. On July 5th., 1937 the thermometer registered 45°C at both places (and no rain at all fell during the two months of July and August).

Returning to 1936, the 40°C heat had spread eastwards through the Rainy River and Thunder Bay regions of Ontario by July 7th. By the 8th., the heat wave had expanded to envelope much of Ontario with a choke-hold at localities west of a line from Long Lac to Belleville. Toronto weathered its hottest day ever at 40.6°C. Further eastward motion of the searing heat was halted on July 9th., along a line stretching from approximately the Abitibi region of Ontario to the Thousand Islands in the upper St. Lawrence River. Many other places also roasted in temperatures of 38 to 40°C with top honours of 41.1°C at Kakebeka Falls and Grimsby. For a second day in a row, Toronto blistered under a maximum of 40.6°C. The following day, July 10th., was the beginning of a three-day peak in the heat wave throughout Ontario and southern Manitoba. It was during this period that provincial record high temperatures were established. On the 11th., and 12th., St. Albans and then Emerson reached 44.4°C, the hottest days ever in Manitoba, while in Ontario, Atikokan and Fort Frances both reached unprecedented values of 42.2°C. Even such localities as Norway House and Berens River, Manitoba, situated north and east of Lake Winnipeg reached 38.3°C and 40.0°C respectively. In Ontario the heat enveloped northern communities such as Moose Factory which reported a startling 35.6°C.

During all this time, the only weather station which reported comfortable conditions was Caribou Island located in the middle of cold lake Superior. The highest temperature recorded there was 22°C. Even though the island is normally a cold, damp, stormy place, its few residents on this occasion were likely the most envied of any in Ontario. In contrast, residents of Pelee Island, located in the warm western end of lake Erie, enjoyed little advantage from their marine environment as temperatures rose above 38°C for seven straight days.

As may be expected with such an extreme spell of heat, the newspapers were overflowing with stories of its impact upon people and the economy. The July 15, 1936 edition of the Toronto *Globe* reported that more than 550 deaths in Ontario were attributed to the heat. In Toronto alone over 225 persons died. Although most of this total was due to heat prostration, many

Continued on page 11

Continued from page 10

drownings occurred as people flocked to lakeside resorts and beaches. Others suffered heart attacks brought on by the shock of entering the frigid waters of Lake Ontario. The Winnipeg *Free Press* of July 18th., announced that a total of 32 people had succumbed to the effects of the heat in the city of Winnipeg (at least 7 were due to drownings). Predictably it was the elderly and already-ill who formed the majority of heat prostration cases.

Besides the obvious human misery, both flora and fauna suffered severely. Agriculturalists throughout the drought area saw their crops shrivel and blacken, resulting in many cases in total crop failures. In the Niagara Peninsula fruit literally baked on the trees. Tinder-dry forests across northern Ontario were ablaze.

But relief was in sight. On July 13th., cool air began pushing into portions of Manitoba and northern Ontario from west of Hudson Bay, and was accompanied by isolated thunderstorms which brought heavy refreshing rain to some locations. By the morning of Tuesday July 14th., the cold front had slipped southward to a line stretching from Lake Ontario to North Dakota and had produced localized hailstorms and tornadoes. Only in extreme southwestern Ontario did the heat linger on (Harrow reached 40.6°C). The cooler air lowered temperatures by as much as 14°C and people breathed more easily.

Are fears justified that heat and drought of similar proportions will re-occur in Canada in the near future? Droughts have been linked to persistent airflow patterns which continually steer moisture laden storms into particular areas, thus depriving other regions of rain. Although much research has been carried out over the years in an effort to understand why such blockages occur in the planetary scale of airflow around the hemisphere, the reasons for this behaviour is still obscure. The question of re-occurrence cannot be specifically answered, but there are some disquieting signs. Firstly, in the U.S. there was a considerable expansion in the arid climate of the dry southwestern region during the summer of 1980 resulting in 1200 heat-related deaths and bad damage to the agricultural and livestock industries. Secondly, persistent blocks in the airflow over the western portion of the continent have been a very common atmospheric feature since 1979 with the general result of dry spring conditions on the prairies, and record losses due to western forest fires, particularly during the summer of 1980. Finally, it has been about 45 years since the peak of the "Dirty Thirties", about the same time interval between that era and the preceding drought of equal magnitude in the 1890's. Perhaps we are soon due again!

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NEWS AND NOTES

NAZI WEATHER STATION ON LABRADOR COAST

A Canadian Coast Guard research group recently discovered the first-known evidence that Germany had a weather station on the shores of Labrador during the second World War.

Dr. Alec Douglas, official historian with the national defence department and a member of the discovery team, said the department has always maintained Germans never made such landings here.

But evidence shows that on Oct. 22, 1943, the German submarine, U-537 slipped into Martin Bay, 32 kilometres south of Cape Chidley on the Labrador Coast to set up a secret automatic weather station.

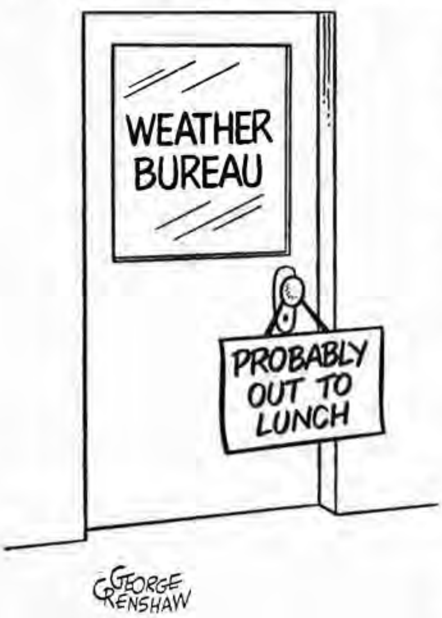
The station, which transmitted weather data to Germany and U-boats operating in the northwest Atlantic until January 1944, was part of an effort to revive a failing U-boat campaign against Allies.

However, the coast guard team was not the first group of people to visit the site since 1943. Mr. Douglas said the station had been dismantled and smashed, and estimates it happened at least 20 years ago.

The historian said he has no idea who had discovered the site, and smashed and took equipment. If it had been discovered during the war, news would have been kept secret. Mr. Douglas speculated that if the Allies had discovered it, they may have dismantled it so the Germans couldn't have replaced the batteries and used it again if they returned.

Mr. Douglas feels there are two important lessons to be learned from the discovery. The first, is the importance of the north as an asset and to what lengths people will go to gain access to information. Second is the realization of what a long and lonely coastline Canada has in the north and the importance of maintaining air patrols over the area.

The discovery was made possible because a retired German engineer, **Franz Selinger,** discovered the log book of the station while researching a book on weather reconnaissance. Mr. Selinger, part of the research team, also came across photos the Germans took at Martin Bay in 1943. From these, he guessed the station's location. The station will be assembled in Ottawa for museum and archival use.



SIXTEENTH ANNUAL CONGRESS CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY

The Sixteenth Annual Congress and Annual General Meeting of the **Canadian Meteorological and Oceangraphic Society** will be held at the University of Ottawa, Ottawa, Ontario, Canada on May 26-28, 1982. The theme for the Congress will be Sea Ice. In addition to invited and contributed papers relating to the general theme, sessions will be held on any other aspects of meteorology and oceanography depending on contributions. Poster sessions may be held depending on response.

Titles and definitive abstracts (less than 300 words) should reach the program committee by February 1, 1982 and should be addressed to **Dr. George Isaac,** Cloud Physics Research Division, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4; telephone (416) 667-4683. Please indicate if the paper is suitable for presentation in a poster session.

Other congress activities, including tours, are planned. In addition, commercial exhibits will be on display during the Congress. Organizations interested in obtaining display space should contact **Brian O'Donnell,** Atmospheric Environment Service, Ottawa, Ontario, K1A 0H3; telephone (819) 997-3511.

EASIER PASSAGE TO THE NORTH

The same phenomenon that makes it chilly to swim at Toronto beaches in the summer may work in reverse in the Northwest Passage, promising thinner ice and easier passage for ships. That's an unexpected finding by oceanographers from the federal Department of Fisheries and oceans who spent the spring of 1981 studying currents and ice in Barrow Strait in the Northwest Territories.

E.B. (Bert) Bennett, the research scientist in charge, said a process called coastal upwelling occurs beneath sea ice in the strait and probably in other portions of the passage. Such upwelling is common along the ice-free coasts of California and Peru and along the Toronto shoreline where surface water is pushed away from shore by winds and replaced by deeper, heavier — and usually colder — water. The cause in Arctic channels isn't wind but the friction of water passing under the sheet of ice attached to land. The drag causes the water to veer to the left of the general direction of flow.

In Barrow Strait, where the current moves steadily eastward, the relatively light and cold water collects under the ice in mid-channel, while the heavier and warmer water flows upward along the south shore. The warmer water slows ice formation, keeping the ice thinner near the shore than in mid-channel, a finding that may be important in routing oil, gas and ore carriers through the 60-kilometre-wide strait.

The researchers from the Canada Centre for Inland Waters (CCIW) will return next year to look at the growth of algae and microscopic organisms under the ice. In principle, the upwelling should encourage marine life. The thinner ice allows more sunlight to penetrate and upwelled waters are usually rich in nutrients. "There may well be more life along the south shore. If that includes large mammals such as seals and polar bears, it could conflict with shipping. That's among the things still to be examined," said Dr. Bennett.

ANSWERS TO ARCH PUZZLE #18
The code indicates (vol: no: page)
(a) Iroquois Falls, Abitibi (3:2:19); **(b)** 1903-6, Gjöa, 6 (2:4:56); **(c)** Inauguration of the Meteorological Society of New Zealand Inc. (2:4:50); **(d)** *Asiak* and *Killick* are buoys operated by Esso to measure wind, pressure temperature and waves in the Labrador Sea (2:4:54); **(e)** AQM S2 - SO_2 (3:3:30), Maestro — wind and gusts (3:2:29), Taylor 3100 — windchill (3:1:14), Munro R100 — rainfall intensity (3:1:14), Comprop — wind including vertical component (2:3:40), WAD 13 — wind display (2:4:62); **(f)** Satellite-borne radar for sounding the ionosphere (2:4:51); **(g)** CO_2 content of the atmosphere (3:2:21); **(h)** Warm frontal passage (2:3:39); **(i)** Desert locusts (3:1:2); **(j)** John Toll (3:1:12); **(k)** Dans les deux grandes agglomerations de Toronto et Montreal (3:2:23); **(l)** Two (3:2:26); **(m)** 381 m (2:4:52); **(n)** Ken Hewitt (2:4:60); **(o)** It's so cold out there they're going to be frozen to their asses (2:3:40); **(p)** U.S. Army Medical Department required their surgeons to keep a record of weather and disease conditions (2:3:38); **(q)** Better insulation, milder weather, lowering thermostat setting (3:1:5); **(r)** Raymond Moriyama (3:2:24); **(s)** Smoke plumes (2:4:53).

TRADE WINDS Edited by Claude Labine

M.I.C. COMPANY AND BAKER INSTRUMENTS.
by Scott Somerville

Recently, ***Chinook*** visited the offices of two companies located in Thornhill, Ontario, both of whom deal with meteorological instruments. However, in spite of the similarity in location and the type of product, the two firms, namely **M.I.C. Company** and **Baker Instruments Ltd.**, are uniquely different. **M.I.C. Company** is a year old firm which deals primarily with sophisticated meteorological instruments and systems, and caters mainly to the needs of industry and government agencies. **Baker Instruments,** on the other hand, is an established company which handles weather instruments suitable for home and recreational use, or for the weather amateur.

Baker Instruments boasts a long history. The founder of the company, **Frederick C. Baker,** worked for **Taylor Instruments** in Toronto from 1916 to 1932 (see ***Chinook,*** Summer 1980) when he decided to move out on his own and start **Frederick C. Baker and Company.** Linking his fortunes with those of a Chicago instrument manufacturer, Baker's company prospered and expanded. Despite the depression of the '30s., the company enjoyed brisk business selling barometers, hygrometers and thermometers, mainly for use in the home. In 1951, the company name was simplified to **Baker Instruments.** Today, the founder's son **J. Donald Baker** is in charge of the business.

In their Thornhill showroom, the company not only displays their line of meteorological instruments, but also other items for marine use such as compasses and binoculars. One unusual item that we noted on the shelf was a barometer which features a built-in radio receiver for the Weatheradio Canada broadcasts.

Unlike Baker Instruments, which serves the leisure market, **M.I.C. Company** not only deals with, but also manufactures, meteorological equipment of advanced technological design. M.I.C's founder and President is **Herb Hohener.** Before starting the company a little over a year ago, he was the Manager of the **Sangamo Meteorological Instruments Division,** but this large concern with international interests was taken over by new owners, and their production of meteorological instruments in Canada was discontinued. **Mr. Hohener,** his wife and family who together comprise **M.I.C. Company,** now carry on the business that Sangamo once held. At the present time the family operated workshop is busy producing precipitation collectors. These were designed by **Mr. Hohener** specifically to collect both wet (rain, snow) and dry (atmospheric particles) forms of precipitation for analytical purposes. With the high degree of public and political interest in the problem of acid rain, the manufacture and sale of the collectors now constitutes about a third of the business.

Another item which accounts for a substantial portion of the business is the **Climatronics** line of weather stations. These devices are in demand by companies involved in the petroleum and mining industry, **Mr. Hohener** explained, and allow them to make meteorological surveys of potential production sites. With its own power supply and transmitter, the weather station is capable of automatic, unmanned operation, a considerable advantage in remote locations, and its portability allows it to be moved easily to new observation points.

M.I.C. Company operates out of the Hohener home, and as we passed the vintage cars which occupy his spare time, **Mr. Hohener** spoke confidently of an expanding future. He looked forward to office and storage facilities, "and don't forget to remind your readers" he said, "that we offer a whole line of meteorological instruments and systems, not just our precipitation collectors and automatic weather stations".

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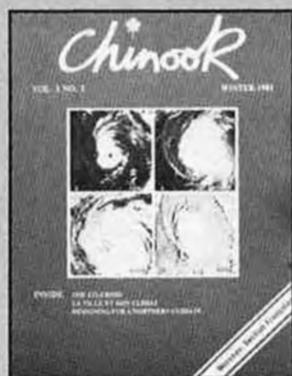

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