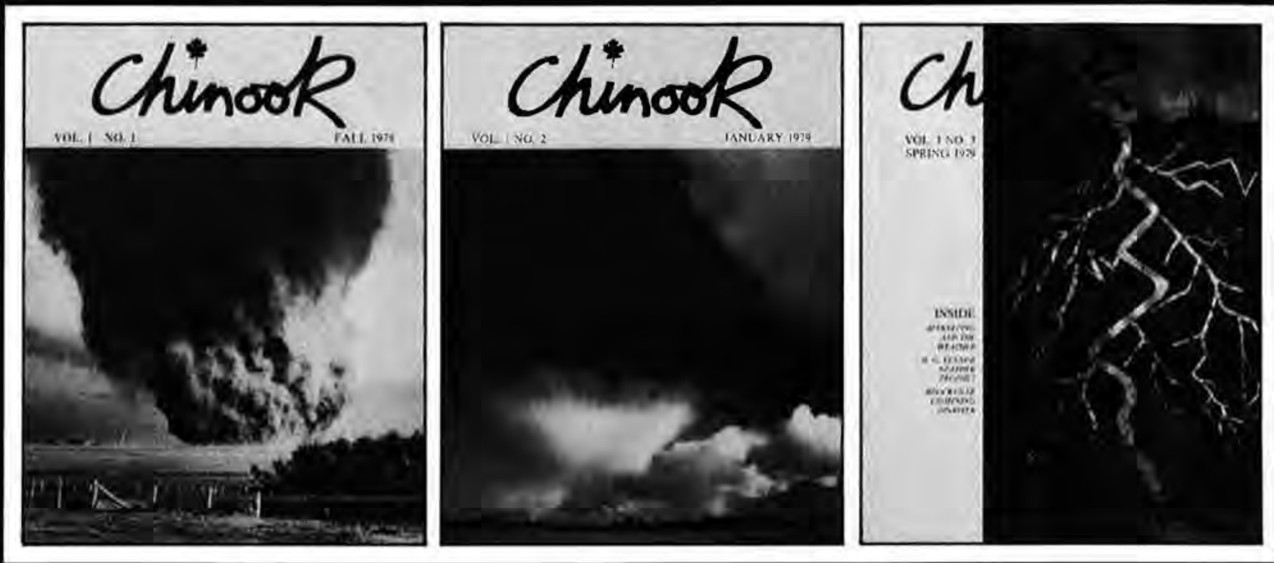
Chinook

VOL. 1 NO. 4 SUMMER 1979

INSIDE *ACID RAIN*
THE COMFORT ZONE
THE BUCTOUCHE TORNADO



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(And thanks to all of you for your encouragement and support. The Publisher)

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Articles

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THE COVER

"Acid precipitation has emerged as a large and hidden cost of our industrialized economy and related lifestyle. I am convinced that there is a price we must pay. And part of that price is, I am convinced, an ultimate change in our lifestyle."

The Honourable Harry C. Parrott, D.D.S., Minister of the Environment, Ontario, February 1979.

Drops of rain nestle attractively upon a maple leaf, the proud symbol of Canada. However, hidden within them and concealed by their pristine surface is an environmental hazard — acid — which has aroused increasing fears and concerns in recent years.

For more about this topic see ACID RAIN by Hans Martin, p. 50.

TWO TORNADOES OF 1953

Looking through the first issue ***(Chinook,*** Fall 1978) in the storm log section, I noticed the disastrous tornado of May 21, 1953 listed as number 8 — an old acquaintance of mine. I well remember that day when the monstrous funnel passed about ½ mile north of the village of Kintore, Ont., where I lived. My schoolmate watched with tears as he saw the house far across the field, his house, disappear. Thankfully no one was in it at the time. Others were not as fortunate. We spent many weeks after that helping to clean up debris, in fact school was dismissed for a time so that we could help the farmers clean up.

A second much smaller tornado (photo) followed almost the same path later that summer in August, but did little damage. My dad, who watched it for several minutes before the snapshot was taken, observed that it had a very long thin tail which doubled back and forth. I can vaguely remember hearing of a tornado in Sebringville on August the 4th., but I can't say if this one was associated with it or not as no one remembers the exact date.

R.D. Hepworth,
Burlington, Ontario

Continued on p. 58

THE COMFORT ZONE

by Bryan Smith

A satirical friend of Dr. Samuel Johnson summing up the climate of Canada said, "for two months of spring, and two months of autumn, you are up to your middle in mud; for four months of summer you are broiled by the heat, choked with the dust, and devoured by the mosquitoes; and for the remaining four months, if you get your nose above the snow, it is bit off by the frost."

Since those words were written, major technological advances in building design, travel, central heating and air conditioning have enabled us to insulate ourselves from inclement weather conditions. However, each and every day we must contend with the outdoors to some degree. In such cases, comfort is our primary concern. The actions we take to ensure our comfort depend upon a large number of factors in various combinations, such as temperature, atmospheric moisture content, wind strength, precipitation or lack of it, sunshine, electrical activity etc., as well as differences in human physiology. There is no unique method of defining the level of comfort, but there are ways of making approximations.

Two comfort indices are commonly employed, namely the "Humidex" and the "Wind Chill Factor". Both of these deal with current atmospheric conditions and will be discussed later. An index is also available when we consider the climate of an area, or the average course of the weather over a period of time. Developed by V. Olgyay, it graphically portrays the comfortability of an area's climate with respect to its temperature and relative humidity. Within the statistical range of 20 to 28°C and 15 to 70% relative humidity, the human body feels comfortable with light indoor clothing while sitting or performing non-strenuous work. Corrective measures are needed to restore the feeling of contentment outside these limits. On Olgyay's graph, the combination of values within the prescribed limits is called the comfort zone. Other combinations can be described as raw, hot and humid, very cold etc. Average values of the daily maximum temperature and the afternoon relative humidity for twelve cities are plotted on the basic graph in order to compare the climate across Canada (page 49). For the sake of contrast, the figures for Miami and Los Angeles are also shown.

Seldom, if ever, has the Canadian climate been referred to as "comfortable". Indeed many, including thousands who leave our borders for vacations in the preferred climes of foreign countries, might agree with the comment by one visiting American dignitary who claimed that Canada has only two seasons — winter and next winter. Voltaire, writing in the eighteenth century dismissed Canada (and her climate) as a "few acres of snow." However, in truth, with the entrance of summer, we have a season worth the long winter wait. For example the graph for Toronto has four months, from June through to September, within the comfort zone, and all provinces, except Newfoundland, enjoy at least two months of comfortable weather.

When using the graphs it must be remembered that the figures are based on average afternoon conditions and divergence from average must be expected. One major reason for such an anomaly occurs in the Great Lakes area when intrusions of tropical air from the Gulf of Mexico (with the characteristics shown for Miami) raise heat and humidity readings much above the norm. During these heat waves, the Humidex comes into its own and becomes a favourite of the news media because they are able to use it to pin a descriptive label on our distress. Also based on the combination of temperature and relative humidity, a Humidex value of 40 (which can be thought of as equivalent to 40°C) indicates that almost everyone is uncomfortable. Such a value would be obtained when the air temperature is 30°C and the relative humidity is a sticky 65%. These invasions of hot humid air rarely visit the prairies and are unknown in B.C. so that Vancouver, Calgary and Winnipeg enjoy a climate relatively free of the sweltering days and nights at times encountered in eastern Canada.

At the other extreme is the Wind Chill Factor which provides a measure of how cold we apparently feel due to the dissipation of body heat by the wind. Because we are at the height of the summer season, suffice it to say that the wind chill effect has been known, especially on the Prairies, to force people to put on a heavier jacket, extra gloves and even a hat — and that's for staying inside. This frigid weather is beyond the lower limits portrayed on the Olgyay graphs, but climatologists have developed tables outlining the percentage probability of wind chill conditions throughout Canada (see further reading).

The Olgyay graphs are just one of a great variety of methods which can be employed to present our knowledge of the climate and to aid in decision-making. The items listed in "Further Reading" will be of interest to those wishing to explore the subject in greater detail than space allows here.

Further Reading

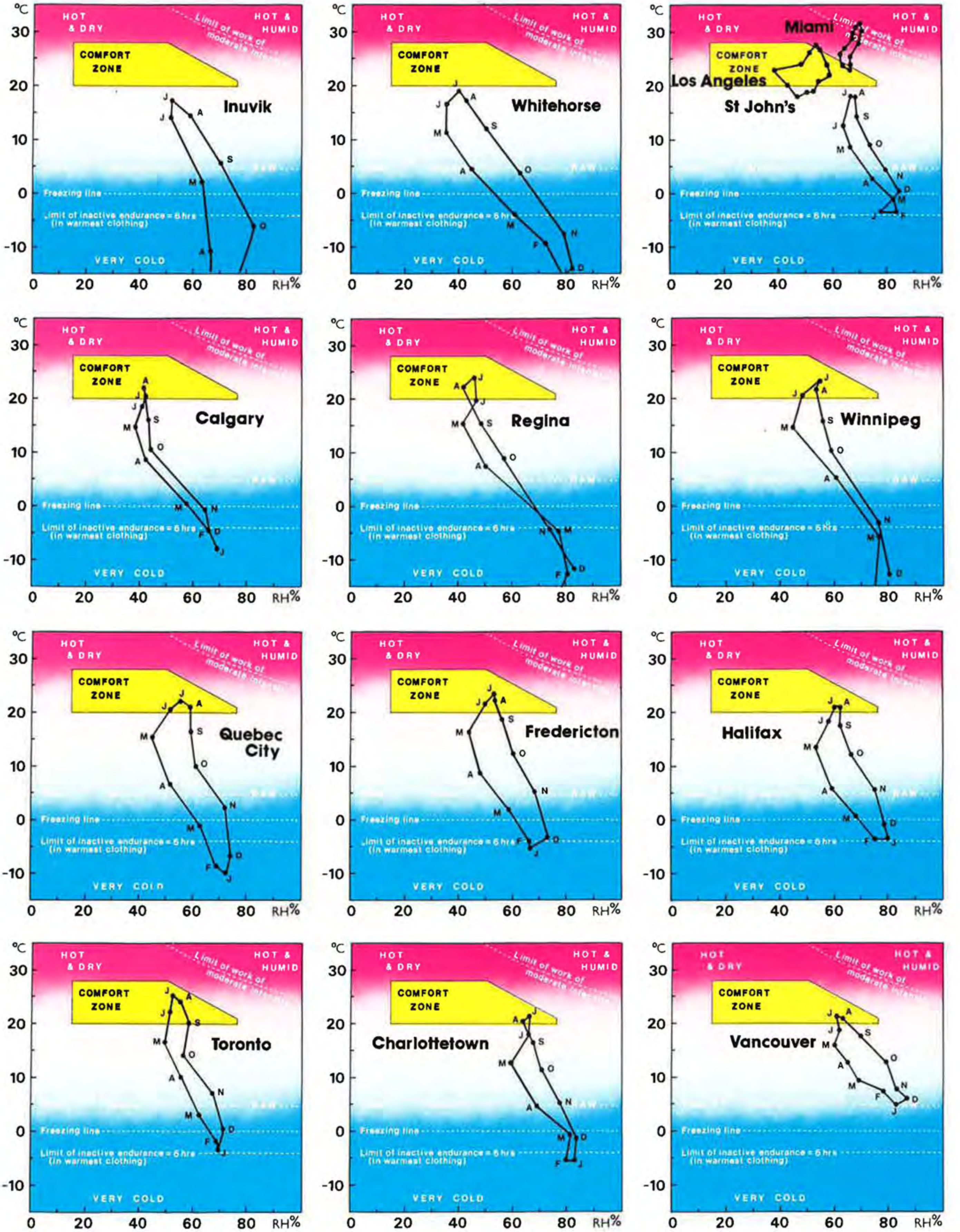
Boughner, C.C. and Thomas, M.K. 1959: **The Climate of Canada.** In *Canada Year Book*, Ottawa.

Crowe, R.B., McKay, G.A. and Baker, W.M. 1977: **The Tourist and Outdoor Recreation Climate of Ontario.** Fisheries and Environment Canada, REC-1-73, 3 volumes.

Falkowski, S.J. and Hastings, A.D. 1958: **Windchill in the Northern Hemisphere.** U.S. Army, Environmental Protection Research Division. TECH REP EP-82.

Thomas, M.K. 1973: **A Bibliography of Canadian Climate 1958-1971.** Environment Canada, Information Canada catalogue no. En56-4373.

Bryan Smith is a climatologist, Environment Canada.


°C
HOT & DRY
HOT & HUMID
Limit of work of moderate intensity
COMFORT ZONE
RAW
Freezing line
Limit of inactive endurance = 6 hrs (in warmest clothing)
VERY COLD
RH%
Inuvik
Whitehorse
Miami
Los Angeles
St John's
Calgary
Regina
Winnipeg
Quebec City
Fredericton
Halifax
Toronto
Charlottetown
Vancouver

ACID RAIN

by Hans Martin

Illustration by F. Fanaki

Scientists and environmentalists in North America, particularly eastern North America, are becoming increasingly concerned over the environmental deterioration being caused by a little known form of pollution. Recently there has been considerable publicity given to one of the aspects of this pollution, "acid rain". In this article, a brief review is given of the problem and of the consequences anticipated over the next twenty years.

To start with, the popular name "acid rain" is misleading. Acidic precipitation is the preferred term, because firstly it is not acid which is falling but rather precipitation which is more acidic than clean precipitation, and secondly, because all forms of precipitation are of importance, including snow and hail. LRTAP, which stands for "long-range transport of air pollutants", refers to the movement of pollutants through the atmosphere by the wind over large distances, and is directly related to the acidic precipitation phenomenon. Pollutants moving long distances through the atmosphere have time to undergo transformation into secondary products, and to react chemically with the water vapour naturally found there, thus producing acidic water vapour. Sulphur dioxide and nitrogen oxides are the two main constituents responsible for this process. In North America it is thought that sulphur dioxide is responsible for about two-thirds of the acidity in precipitation, while nitrogen oxides are responsible for about one-third. The sulphur dioxide is mainly a product of ore smelting industries in Canada, while in the U.S. it comes primarily from coal-fired power generators. Nitrogen oxides come from the transportation industry.

The study of LRTAP differs significantly from the conventional study of local pollution for several reasons. First, the concentration of pollutants encountered in LRTAP are totally within air quality standards and in some cases below conventional detection limits. Second, the regions in which the pollutants are deposited are at distances of the order of 1000 km from the sources, and third, the specific sources which are responsible for the pollutants are not identifiable.

The current concern over the LRTAP problem and the resulting acidic precipitation is well founded, and the prospects for the next 10 to 20 years are grave, if not alarming. Evidence is accumulating from numerous studies in a wide variety of disciplines, which suggests that eastern North America will be subjected to an environmental degradation in the next two decades at least as severe in magnitude as that which has occurred in the Scandinavian countries over the past two decades. In the late 1950's, scientists there observed that the acidity of freshwater lakes and streams was increasing to a point where large numbers of water bodies were no longer able to support fish. Their studies determined that the cause of the deterioration was not a consequence of local industrial activities, but rather, was due to the industrialized areas of central Europe and Great Britain. Three elements combined to create an LRTAP problem, namely that large regional sources existed in the first place, that meteorological conditions favoured transporting the materials from them to remote areas, and finally that these areas were sensitive to the impact of small but continuous concentrations of pollutants.

In North America there is a parallel situation. The industrialized regions of the northeastern U.S. and southern Ontario, Quebec and the Maritimes produce approximately 25% of the total man-made emissions of sulphur dioxides. Weather conditions in this region carry pollutants from these large sources over long distances into the remote and sensitive regions of Ontario, Quebec and the Maritimes, and in the U.S. to the Adirondacks where the soils, because of their low buffering capacity, are unable to completely neutralize the acidic precipitation. Soils with a high limestone content have a large neutralizing (or buffering) capacity, while soils that are derived from granite bedrock, such as the recreational areas of central Ontario, Quebec and most of the Maritimes, have a very low buffering capacity.

Deposition of acidified precipitation on such sensitive areas can initiate a series of events which impinge on both the aquatic and terrestrial ecosystems. On the terrestrial side, it can inhibit the growth of lichens which play a major role in the cycling of minerals in the soil and in the fixation of atmospheric nitrogen. In addition, it can inhibit the activity of bacteria responsible for the break-down of biological materials on the forest floor. Both these effects reduce the enriching process of the forest soil. As acidic water percolates through the earth several chemical processes can occur, among them the increased leaching of nutrients which reduces soil fertility. In this regard, it is not known to what extent acidic precipitation affects forest productivity, partly because it takes 50 to 100 years to assess productivity, and also because other influences, such as harvesting practices, climatic change and insects, can have a marked effect as well.

As the water moves from the earth into streams and collects in lakes, other symptoms of malaise appear which are more quickly noticed. Perhaps the most dramatic is the decrease in the number of fish species in a given watershed, and in the final stages, the total disappearance of all fisheries. This process has been observed in Ontario lakes and, as more data becomes available, it is anticipated that many more watersheds will be identified where deterioration in fish stocks have occurred. It is estimated that approximately 50,000 lakes in Ontario alone may be subjected to serious damage within the next two decades.

Although the process of deterioration of land and water ecosystems is slow and in general undetectable to the casual observer, there is one noteworthy event which is rather dramatic. This is the so called 'spring slug'. During the winter, snow accumulates in some areas without melting for periods of up to five or six months. The pollutants that accumulate in the snow remain there until the first warm spell in the spring. Then within a few days nearly all the contaminants are flushed out of the snow layer with the first 10% of melt. This sudden and relatively toxic flow of water enters the streams and shallow areas of lakes where spawning has occurred. The result can be disastrous, occasionally killing all members of the youngest year class of a given fish species.

Environment Canada and the Department of Fisheries and Oceans undertook a major research program some time ago to assess the current state of the environment, and determine the impact of LRTAP. Continuous discussions are maintained with provincial governments and American institutions who also operate major research programs, in order to evaluate control strategies, and to provide policy makers with the information necessary to develop an air treaty between Canada and the U.S. There is an element of urgency in all the work currently underway. The environment in certain areas is being altered, although the extent of change has not yet been defined. It is known that in many cases the degradation occurring is irreverisible. There seems little doubt that the long-range transport of air pollutants phenomena, and the associated acidic precipitation, is the most pressing environmental problem confronting eastern North America today.

Dr. Hans Martin, AES, is the Manager of the Canadian LRTAP Program.

A PERSPECTIVE ON ACID RAIN CAUSES

The regular pattern of daily life in any modern society requires a steady, uninterrupted flow of certain essentials which can only be manufactured by using great amounts of heat. Naturally, this process breaks down the fuel (often a fossil fuel such as oil or coal) into its chemical constituents, some of which are released in undesirable quantities into the atmosphere. In 1973, T.D. Brown, a research scientist in the Canadian Combustion Research Laboratory, Ottawa (see further reading), published calculations showing what proportion of such combustion by-products are attributable to the needs of a family unit of four. The diagram below is derived from Brown's figures and is based on the assumption that the family unit demands:

(a) about 12,000 kWh of electricity per year, and that this has been generated by a fuel-oil-fired thermal power station at a typical over-all efficiency of 25% (actually a low figure for modern stations which operate at about 33 or 34% efficiency);
(b) 3000 litres of fuel oil per year for space heating;
(c) 3800 litres of gasoline per year.

In the late 1960's and early 1970's growing concern about dirty air caused governments at both federal and provincial levels to reorganize and form specific departments to deal with the protection of the environment. At first, the emphasis of standards was directed at improving the quality of air at ground level around major polluting sources. This resulted in taller stacks, built hopefully to carry pollutants to levels of the atmosphere where stronger winds would carry them away to be diffused over a larger area. A consequence of this step has been the emergence of a new problem — the long distance transport of the pollutants and the transmutation of sulphur gases and nitrogen oxides into acid rain during the course of the journey.

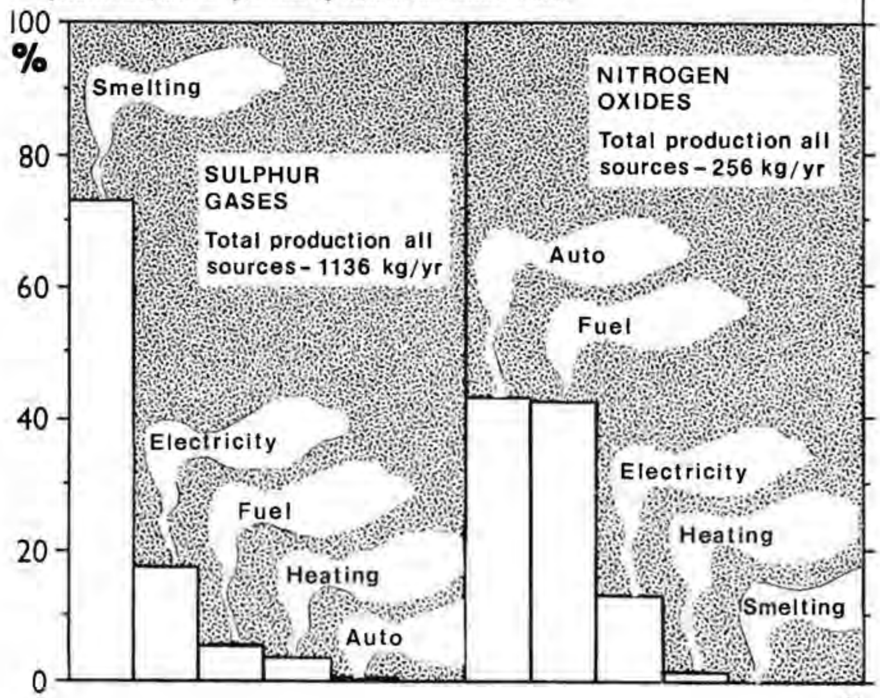
Actually, acidified rain as such is not new. The weathering of tombstones for example provides evidence that chemical attack has occurred within historic time. The inscription on the marble column shown in the photograph, is nearly illegible after 109 years. This is due to the fact that the calcite in the marble has been attacked by carbonic acid formed in rain by carbon dioxide released from factories and dwellings. By comparison, inscriptions on old stones of granite or slate show little sign of decomposition because this material is impervious to the acid.

Further Reading

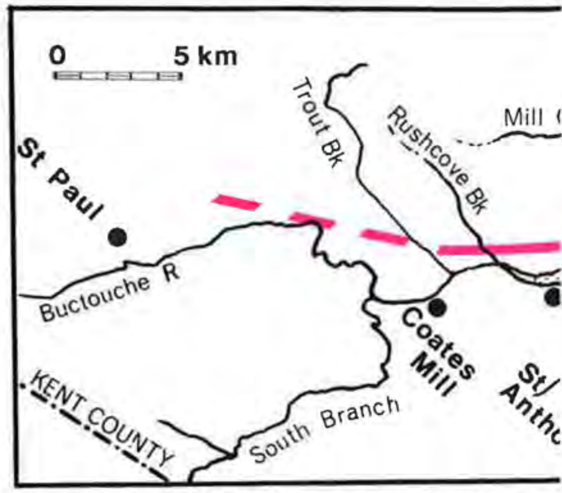
Brown, T.D. 1973: ***Air Pollution and Energy Reserves. Civil Service Review,*** vol. 46. no. 1 pp 6-12.

CARBONIC ACID IN RAIN OVER A PERIOD OF 109 YEARS has attacked the calcite in a marble tombstone and made the inscription almost illegible.

THE AMOUNT OF POLLUTING GASES PRODUCED PER YEAR in order to serve some of the major needs of a family unit of four people. Other pollutants, such as carbon monoxide and hydrocarbons, are also produced by some of the sources shown.



THE BUCTOUCHE TORNADO



BELOW. ARTIST DAVID WICK'S IMPRESSION OF THE SCENE AT THE HEIGHT OF THE TORNADO'S FURY. Working from the detailed contemporary account written by the St. John Daily Sun correspondent, the artist has chosen the moment when the tornado began its havoc at the Buctouche Parish Church and Convent. The wrecked bridge is visible, and so is the bridge debris that was embedded in a sandbar a short distance downstream. (David Wick instructs an extension course in art for Loyalist College, Belleville, Ontario, and is also the founder of the Lennox and Addington Guild of Fine Arts, P.O. Box 313, Napanee, Ontario K7R 3M4).

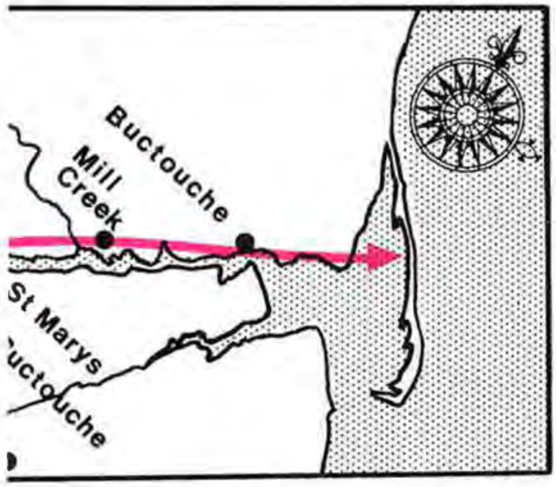
According to Godfrey Girouard of St. Mary's, New Brunswick, the front of the storm seemed very black, with a luminous centre as if charged with electricity. Although he didn't yet know it, a tornado demolishing everything in its path that wednesday afternoon, August the 6th., 1879, was bearing down upon him. When it arrived at about 5 p.m., it came in the shape of a conical cloud with its apex touching the ground and making a terrible roar. He suddenly saw trees torn from the ground by the roots and carried along in the funnel. As he watched in disbelief, a building was lifted into the air and seemed to literally boil into fragments before being thrown upon the ground in ruins. His relative, J. B. Girouard, was among the first to lose his life to this meteorological monster.

Father L.J. Ouellette, Parish priest of St. Mary's, and Girouard's neighbour, was not at home. He had just crossed the ill-fated Buctouche bridge and was soon to discover that not only was his own property lying in rubble, but that a number of his parishioners were grievously injured, some were dead, and many were dazed by the loss of their homes, their barns and their livestock.

The storm had originated somewhere in the forest west of the Rushcove Brook. Its path, 500 metres wide, could be observed stretching through the trees as far as the eye could see. From the forest edge it followed a sinuous 16 km track along the north bank of the Buctouche River, maliciously picking on some homes and farm property, then providentially curving around others. The track ended only after the Buctouche bridge and the Buctouche Church were wrecked, and the tornado swept out to sea. In all, the tornado snuffed out at least 5 lives, possibly 7, severely injured another 10 people and left 25 families homeless and destitute. Shock-waves of grief swept the settlers of the area, many of whom were already impoverished from trying to wrest a living from the unyielding soil. Those who were just struggling out of debt found the fruits of their years of labour literally dashed to the ground.

A Relief Association was quickly formed in Buctouche to provide aid to the victims. Assistance quickly flowed in from the surrounding communities of Petitcodiac, Shediac and Richibucto, and the sufferers themselves industriously began the work of rebuilding. Ironically, in the village itself, the reconstruction including the rebuilt provincial bridge, was to last for only 13 years. On September 29, 1892, a terrible fire set by an arsonist burned 57 houses and stores to the ground. Over half the village, as well as the main arch of the Buctouche bridge and public wharf, was reduced to ashes while the residents watched powerless to intervene because they had no fire extinguishing apparatus. As if this mischief were not enough, Buctouche suffered grief during two other natural disasters. On August 25, 1873 the remnants of a tropical storm wrecked the old Buctouche bridge, schooners, houses and wharves, and took the lives of three lobster shantymen. Again, on October 29, 1879, just weeks after the tornado, another North Atlantic hurricane caused very bad damage to property along the east coast of New Brunswick, including Buctouche. In less than twenty years, the Buctouche bridge had to be rebuilt three times!

Two officials, Mr. Reynolds and Mr. Everett, were sent from St. John to



ABOVE. THE PATH OF THE BUCTOUCHE, NEW BRUNSWICK TORNADO of August 6, 1879. The solid red line indicates the confirmed damage track (width not to scale), while the dashed section of the line indicates that insufficient information is available to properly locate it. West of Rushcove Brook, Francois LeBlanc, a well known local trapper traced a tangle of fallen trees in an almost direct line through the depths of the woods. It is unknown where the tornado actually originated, or for that matter, how far it travelled once it left the land.

determine the extent of the tornado disaster and the needs of the victims. They reported that a total of 42 houses and 52 barns were either totally destroyed or badly damaged, in addition to the bridge, the new school and the Buctouche Parish Church. This is a remarkable number in view of the rural character of the area and the fact that fortune spared the main section of Buctouche. The news quickly spread, and soon the newspapers in Fredericton and St. John published lists of generous individuals who had donated to the relief funds. A number of philanthropic ladies in Sussex County, aided by merchants and others, donated clothing, furniture and other necessities.

Also dispatched to the scene was a correspondent for the St. John *Daily Sun.* He made an extensive survey of the striken area and wrote a very lengthy account which appeared in the newspaper of September 3, 1879. In his article he stated that his instructions were "to trace the course of the storm to its beginning so far as possible, observe its effects, and generally to note any incident which might be of interest to the meteorologist who should hereafter desire to make a study of the phenomenon." It has taken almost exactly 100 years for anyone to take note of this unknown man's work, but now at long last his efforts are finally vindicated.

As instructed, the *Daily Sun* correspondent followed the aftermath of the tornado along its entire track. Starting where it had emerged from the forest the correspondent began interviewing the victims. A number of almost unbelievable, but true, stories emerged. One of the first casualties was a Mr. Meunier who saw the storm coming through the woods, tearing up the trees and whirling them in the air. His wife, who had rushed out of the house with a young child in her arms, was blown along the ground until caught by a neighbour and held to a tree. The Meuniers' home disappeared before their eyes. Further along the track, sturdy rafters were found driven more than a metre into the solid clay so that not even a yoke of oxen could pull them out. The course of events at the farm of Anselm Allain, who lived just to the east of St. Mary's, is typical of a tornado's freakish behaviour. Mr. Allain's large barn, smashed to kindling, was first to go. It was quickly followed by other buildings including his house which had been built the previous summer. He was lying ill in bed when the tornado struck and was carried, bed and all, with the debris for more than 20 metres. He was found unconcious, his face badly cut and his leg and foot injured. His son who was standing beside him, was thrown into the cellar but luckily escaped unhurt.

It was in the vicinity of Mill Creek that another fatality occurred. Thomas Ward's wife and 5 children were on the north shore river road near their home when it was struck by the storm. A flying beam hit one little girl, breaking her leg while her sister who was just passing a blacksmith's shop, was buried beneath the ruins as it collapsed. The remainder of the family were blown into a ditch. Mr. Ward's son, "an intelligent boy of 16" said that while lying there, a cow was rolled over him, slightly hurting his knee.

Sweeping eastwards, the tornado took more lives as it crossed the Micmac Indian reservation, then took a swing at the Macaulay ship-yard, Powell's Tannery and a new school house just completed at a cost of $1200. From there it headed for the three-span bridge which connected Buctouche with the road leading south to Shediac. The centre and southern spans were carried 100 metres while the northern span was moved only a little out of line. The last blow dealt by the tornado before it disappeared over the ocean, was delivered to the Buctouche Church and Convent. Father Michaud, the Parish priest narrowly escaped injury himself, but most of his buildings were badly damaged. Windows burst outwards due to the low pressure created by the whirling vortex, and with them came pews and valuable paintings.

From the few meteorological reports available, it appears that thunderstorms, hail, high winds and 25 mm downpours were widespread throughout the province. A weather map for the day indicates that a cold front crossing the Maritimes was responsible for the thunderstorm activity.

It is conjectured that tornadoes are fairly frequent in New Brunswick, particularly in the very sparsely populated interior which tends to much hotter in summer than the ocean-cooled rim of the province. The Buctouche Tornado is in fact seventh on the list of Canada's most disastrous tornadoes ***(Chinook,*** Fall 1978). However, with a modern population density of only 8 people per square km, it is not surprising that in many cases tornadoes can and do occur unobserved. The Buctouche tragedy should be remembered, if only to serve as a reminder that New Brunswick is not immune from the ravages of the severe variety of tornadoes.

Acknowledgement

Thanks are due to Scott Somerville, a regular contributor, who helped research the historical meteorological aspects of this storm.

Further Reading

Canada, 1879: *Monthly Weather Review.* Meteorological Service, Department of Marine and Fisheries.

Wide World Photo

The vigorous and windy weather usually associated with March was reserved for April this past Spring. An intense storm which crossed the Great Lakes area during April 5th., and 6th., 1979, rivalled the worst of the winter season. On the evening of the 5th., it was centred near Sault Ste Marie and dumped rain accompanied by thunderstorms (see "Tornadoes") in southern Ontario and snow in the north. The rain changed to snow in the south overnight as temperatures fell below freezing. On the 6th., winds averaging 50 to 65 km/h with gusts as high as 115 km/h ravaged the countryside. Blowing snow reduced visibilities to near zero in the snowbelt areas and along the north shore of Lakes Erie and Ontario.

Widespread property damage was caused by the howling arctic winds which followed the storm centre, and at least nine people were reported killed in storm related accidents. On Highway 400, well known for treacherous winter snow squall hazards, two massive accidents involving a total of 60 cars occurred near Bradford. In the city of Toronto, large panes of glass were torn from office buildings, roofs were ripped from houses, people and bus shelters were bowled over and rolled along the street. To the north, three light planes were flipped over at King City Airport. Throughout southern Ontario, trees were blown down causing damage to buildings and vehicles as they fell, and several cases were reported of pick-up trucks being overturned. Downed hydro-electric wires caused major power failures for a total of 55,000 homes in London and Peterborough cities, Dufferin County and the northern portion of Peel Regional Municipality.

At the eastern end of Lake Erie, the cold westerly winds caused a 2 m surge in the lake level. Rafting ice carried by the rising water threatened shoreline properties and also blocked the flow of water over the U.S. Niagara Falls. The flow was temporarily reduced to 0.5% of its normal rate and then cascaded to 4 times normal once the ice jam cleared. At the west end of the lake, the *Goody II* and other vessels at dock in Amherstburg were grounded as the lake level fell in response to the high water at the other end.

Meanwhile a very serious drama was being enacted elsewhere on the lake. The 5200 metric ton Canadian freighter *Labradoc,* loaded with corn and carrying a crew of 20, was floundering in 5 or 6 m waves off Fairport Harbour, Ohio. During the early morning hours of the 6th., the cargo had shifted causing the vessel to list dangerously 27 degrees to port. Rescue efforts by U.S. Coast Guard boats, Canadian Coast Guard helicopters, as well as by an ore carrier, the *Canadian Mariner,* were thwarted by the high seas and storm force winds. By late morning, a joint helicopter — C 130 operation by the U.S. Coast Guard, the U.S. National Guard and the Canadian Armed Forces plucked all but Captain Ray Chambers and 4 crewmen from the partially awash deck of the freighter. Later, when it appeared that the ship's interior was beginning to break up, the hatches were taking in more water, and without enough power to steer, the remaining crew were also airlifted to safety one at a time in a small chair hoist. Although given up for lost, the *Labradoc* survived the pounding due primarily to the Captain's efforts to right the ship by flooding sections of it. Shortly after the final evacuation, the wind dropped and on Saturday, April 7th., the Canadian tug *Atomic* found the *Labradoc* about 65 km northwest of Cleveland, took her in tow, and headed for the shelter of Point Pelee.

TORNADOES

Ontario

Thursday, April 5, 1979, 2130 EST. The season began fairly early with the first tornado reported about **5 km north of Leamington.** Travelling from southwest to northeast, it slashed through the tobacco farm of George Stasko levelling 4 of his storage barns. Marble sized hail drove him to the shelter of his house, and while watching for the storm to pass he saw a "huge black, perfect funnel" cloud outlined against the glow of Leamington's lights to the south, and also illuminated by frequent flashes of lightning. He observed the tip of the tornado swishing back and forth and said that it moved quickly out of sight. Neighbouring barns, greenhouses, garages and other farm outbuildings were destroyed along the 5th., 6th., and 7th., concessions of Mersea Township. Fortunately there were no deaths or injuries. Weather radar located near Exeter indicated that the top of the tornado stormcell reached an altitude of about 7 km.

Thursday, May 10, 1979, 1655 EDT. A funnel cloud was observed to dip very briefly from a thunderstorm **south of Toronto** to the surface of Lake Ontario. Weather radar indicated that the storm was about 11 km south of the Beaches and was moving from west to east at 25 km/h.

Monday, June 4, 1979, 1930 EDT. Len McTaggart, a Dominion Pegasus Helicopter pilot was just leaving **Windy Lake** enroute for Sudbury. To the northwest he saw a tornado funnel cloud raising dirt and dust as it moved through the forest.

Sunday, June 10, 1979. 1925 EDT. During the afternoon, hot and humid air of tropical origin was being levered eastwards across southern Ontario by air from the Arctic. Maximum temperatures which reached the 30°C mark on Sunday, fell to the 8° to 12°C range the following day. Along the boundary zone between the two airmasses, a long line of thunderstorms developed, their tops reaching altitudes as high as 14 km. One particular storm cell produced a tornado which leapfrogged across the city of **Brampton** from west to east, causing an intermittent trail of damage about 100 m in width, and 5.5 km long.

TORNADO DAMAGE IN BRAMPTON. A man picks his way through roof rubble on Hansen Road about half-an-hour after the tornado struck.

The worst of the destruction, about 0.8 km in length, was confined to a lightly populated commercial and industrial area. Moving eastwards along a sinuous path at a velocity of 60 km/h, the tornado went on to accomplish all its dirty work in about 5 minutes. Apart from the scare suffered by Jose Aguiar and his family when their car was picked up and spun around, there were no injuries in spite of the masses of heavy asphalt roofing, sheet metal siding, concrete blocks and scantling sent flying through the air. Brampton Fire Station number 1 lay directly in the path of the storm, but the crew there saw debris spiralling counter-clockwise above their heads as the tornado funnel lifted back towards the clouds.

Altogether, 16 factory buildings were damaged (mainly their roofs, although in one case, a 30 m section of concrete block wall was burst outwards leaving a gaping hole); several residential homes suffered roof damage; a number of automobiles and boats had to be written off at neighbouring car and boat dealerships; and broken trees and hydro lines caused expensive cleanup and repair operations.

The same day at approximately 1800 EDT, a storm, probably a tornado, and part of the same line of thunderstorms, caused intermittent damage from **Arkona** eastwards to the north-central section of **London.** The damage was worst in London where trees were uprooted and thrown against homes and cars, and roofs were torn from some buildings.

Saskatchewan

Monday, May 21, 1979. 1845 CDT. About **30 km north of Regina,** farm property was damaged and timbers driven into the ground by a brief tornado touchdown. No injuries.

1928 CDT. **Regina.** One funnel cloud was observed over the city itself, but did not reach the ground. Another tornado funnel looking "like a big oil fire burning from the ground" hit the Saskatchewan Wheat Pool elevator reportedly causing $7,000 damage to the roof. On the east side of the city it destroyed three camper trailers.

A PLUME OF VEGETATION DAMAGE

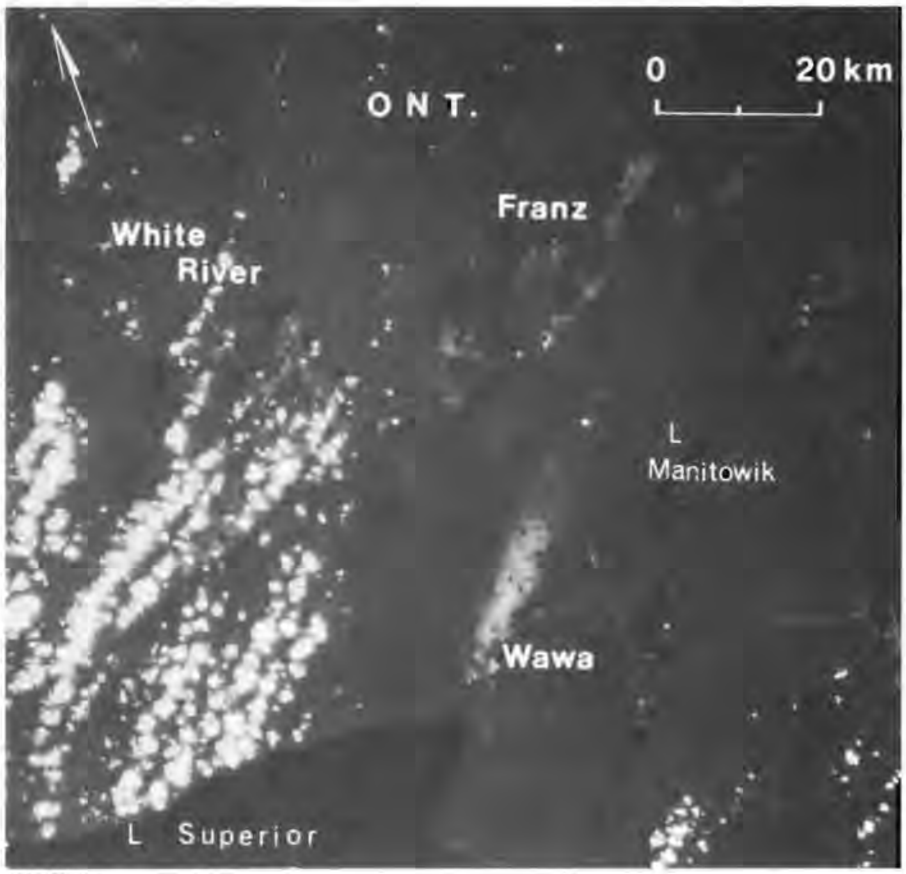
The picture below was taken on August 3, 1973 by the Landsat spacecraft from an approximate altitude of 917 km. This image reveals man's modification of the natural environment in the vicinity of Wawa, Ontario, where the main industry is an iron mine with an associated sintering plant. Over the years, prevailing winds have carried sulphur dioxide fumes away from the plant causing a plume of downwind vegetation damage about 900 km^2 in area. In the centre of the plume, the kill is complete for a distance of about 15 km and the rocky earth's surface shows in the picture as white in contrast to the dark shade of the surrounding forest. Logging operations can also be seen as mottled irregular white patches where the trees have been stripped away.

Because the purpose of this particular satellite system is to gather information applicable to Earth resource management, its field of view and resolution is smaller than for meteorological satellites. Landsat can "see" objects as small as about 80 m, and if the contrast of adjacent objects is great enough, even smaller widths can be distinguished. In the picture, roads about 10 cm wide can be clearly seen.

The rocks in this region are the granites and gneisses of the Canadian Shield which offer no buffering protection against the action of any acidified rain which may fall. Besides industrial activity, it is known that forest fires also contribute to the acidification of precipitation, although the extent of environmental changes due to this cause remains unknown.

At Wawa, a sampling site is operated by the Atmospheric Environment Service, which is one of 11 such installations in the Canadian Network for Sampling Precipitation (CANSAP). Each month a chemical analysis is made of the precipitation collected in order to investigate the presence and concentration of sulphates, nitrogen compounds, chloride ions, and metal ions, as well as to record the level of acidity or alkalinity and electrical conductivity.

WINDOW ON WEATHER



ISIS Photo

NEWS AND NOTES

THE 18th., CANADA-WIDE SCIENCE FAIR

The Canada-Wide Science Fair is an annual event sponsored by the Youth Science Foundation. It was held this year at the University of Western Ontario, in London and attracted 170 entries from senior and junior high schools from coast to coast. The bright young people exhibiting their projects and competing for a dazzling variety of prizes and medals, reached this final level of competition after surviving a grueling round of local and regional science fairs in which more than 30,000 student hopefuls participated.

In many cases, what began as an unsophisticated experiment in a student basement, garage or bedroom, finishes as a high calibre, complex and innovative effort. Take for example the junior level project of **Ian Kroll** and **David Greening,** both grade 8 students at the Scott Bateman Jr., High School, The Pas, Manitoba. Their "Hurricane Machine", a device which creates a visible, rotating column of air to demonstrate the motions within hurricanes and tornadoes, won the $100 Canadian Meteorological and Oceanographic Society award. Part of the acknowledgement for their project goes to Mrs. Greening "for letting us work in her basement", and to Mrs. Kroll "for letting us build the project in her kitchen".

At the senior level, **Amanda Hubbard** and **Stella Couban,** grade 12 students at Sir John A. Macdonald High School, Five Islands Lake, Nova Scotia, were involved in a more sophisticated study concerning the effects of acid rain on plants. Each year, according to the Youth Science Foundation (YSF), at least one Canada-Wide participant patents his or her work.

A very broad range of entries were involved in the 1979 Fair covering the Life Sciences, Physics and Engineering categories. The hit of the Fair was **Rzero Bzero,** a complicated radio controlled robot built by eight students from Algonquin Secondary School in North Bay, Ontario. It

Continued p. 57

ANSWERS TO ARCH PUZZLES 3 AND 4 (Spring 1979 issue)

3 (a) Each is a leap-year beginning on Wednesday, so each year had 53 Wednesdays and 53 Thursdays.

(b) The digits of each add up to 20.

(c) Turn them upside down and they read the same.

4

F R O N T
R O F O R
O U T E R
S T E A M
T E N T S

Collection Metropolitan Toronto Library

ARCH PUZZLE No. 5

Called "The Great Animal Puzzle", this picture was printed in *Vennor's Almanac* for 1883 (***Chinook***, Spring 1979). Careful inspection of the hidden beauties of the landscape will reveal 21 animals hidden there. You should be able to find a lion; tiger; rhino; elephant; mule; alligator; wolf; fox; porcupine; bull; beaver; monkey; dog; giraffe; camel; eagle; owl; parrot; deer; snake and duck. There is one further figure to be found in the foliage, namely the venerable monk St. Jacob. Herein lies a real puzzle. Who was St. Jacob? It may be of help to know that this picture was really an advertisement for St. Jacob's Oil, the Great German Remedy, a liniment which was widely used in Canada during the 19th., century and also known as St. Jakob's Oel. As depicted in this picture, St. Jacob is supposed to be calmly meditating upon the immense benefit brought to man and beast by his wonderful discovery of this proprietary product.

In the Yukon, St. Jacob's Oil had a rather unusual connection with the weather. Do you know what it was? Well there it is puzzle fans. You should quickly begin locating the menagerie hidden in the picture, but the historical questions are much tougher. Answers next issue.

VOLUME ONE INDEX

A list of the authors, articles and advertisers in ***Chinook*** Volume I, issues 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.

NEWS AND NOTES Cont'd. from p. 56.

delighted crowds of spectators and was kept busy buzzing, humming and performing for T.V. cameras. ***Chinook*** interviewed several of the exhibitors who had weather-related projects, and their work will be featured in future issues. Check forthcoming "Weather Amateur" columns for the **Hubbard** and **Coubans** "Acid Rain" project; "Snow Crystals" by **Donald Netolitzky** of Medicine Hat, Alberta (which won him a silver YSF medal in the Junior Physical Sciences category, as well as a Bell-Northern Research Ltd., $200 cash prize and an all expense paid three day scientific excursion field trip to the Bell Laboratories in Ottawa); and the "Hurricane Machine" by **Greening** and **Kroll.**

UNIVERSITY OF TORONTO CLOUD PHYSICIST RECEIVES PATTERSON MEDAL

Professor Roland List of the University of Toronto's Atmospheric Physics Program was awarded the 1978 Patterson Medal during the 13th., Annual Congress of the Canadian Meteorological and Oceanographic Society (CMOS). On May 31, 1979, to the warm applause of nearly 300 delegates at the University of Victoria, **Professor List** accepted Canada's most prestigious meteorological award from **Dr. Warren Godson** who represented the Atmospheric Environment Service (AES).

Professor List, a Fellow of the Royal Society of Canada, earned his Ph.D in Physics in Switzerland. He joined the Department of Physics at the University of Toronto in 1963 and has participated in United Nations activities dealing with weather modification and also the U.S. space shuttle program. He is currently studying the physics of the formation of precipitation, with emphasis on the development of ice in clouds.

The national award is made annually for outstanding achievement in meteorology. It was established in 1946 in honor of **Dr. John Patterson,** Controller of the Meteorological Service of Canada from 1929 to 1946. When presenting the award, **Dr. Godson** cited **Dr. List** for his international acclaim in hail and weather modification research and for his distinguished contribution to world meteorology.

A glitter of prizes awarded by CMOS were also presented. **Dr. Christopher Garrett,** Dalhousie University, Halifax, won the President's Prize in recognition of his work in physical oceanography, while **Dr. John Reid** of AES was awarded the Dr. Andrew Thomson Prize. **Lorne McArthur,** U. of B.C. took the Graduate Student Prize and a group of weather forecasters from the Quebec Forecast Office won the Rube Hornstein Prize.

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TO THE EDITOR from page 47

ERROR IN TORNADO LIST

I was pleased to read Vol. 1, No. 1 of ***Chinook*** recently as it passed through our Department. I hope that it will come to the attention of the many non-specialists who have a strong interest in our weather and climate. I would like to correct one error in the list of disastrous tornadoes on page 10 of your first issue. On July 30, 1918 (no. 21) one person was killed near Tolland, south of Vermilion, possibly by a tornado. However, on August 14, 1907, three persons were killed by a tornado which struck a ranch along the Battle River just south of Tolland, Alberta. In this case there were numerous reports of the funnel, and of a "waterspout" as it crossed the river.
Keith D. Hage
Professor, Department of Geography
The University of Alberta.

(There was an additional error in number 10 on the list. The date of the Merritton "Cyclone", Ontario was actually September 26, 1898. Ed.)

ANOTHER CYCLOSTORMOGRAPH

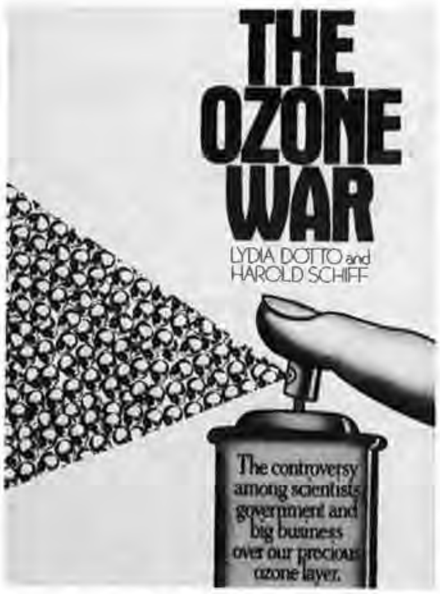
Thank you for sending the copies of ***Chinook***. The office (St. Marys Journal Argus) took one and surprised me by putting your article ("St. Mary's Cyclostormograph", ***Chinook***, Winter 1979) in our paper. I even had some fan mail, a letter from the weatherman in Ottawa, stating they have a similar machine. His grandfather bought it years ago.
Mrs. Marjorie Tuer,
St. Marys, Ontario.

THEY ARE CAUSED BY AIRCRAFT

With regard to the article "Window on Weather", (***Chinook***, Spring 1979, p. 40), there is little doubt that the anomalous lines referred to are caused by high flying aircraft. In other words, vapour trails. I have often seen these trails which widen very quickly with time but are still visible for hours after, and at times give marked reduction in the warmth reaching the surface in the Victoria area.
R.P. Messum
Victoria, B.C.

THEY ARE PROBABLY FROM SHIPS, BUT . . .

The article "Window on Weather" in your Spring 1979 issue intrigued me to the point where I felt compelled to offer another explanation for the unknown lines. As has been mentioned they are probably from ships moving towards Vancouver, but I feel they are the result of mixing of the cool deeper water and that of the warmer upper level. The temperature gradient, albeit small, would be noticeable for some time and possibly as long as the time mentioned in the article. They are visible in photo number 2 due to the disturbance of the water and seaborne plant life.
Philip Mudge, Forestburg, Alberta.



Doubleday and Co. Inc., Garden City, New York. 1978. 323 pages. Hardcover $12.50

Although technology has advanced almost explosively since the dawn of the Nuclear Age, the realization that some of these advances can inadvertently harm Nature's life support systems has been very much slower to develop. The life-preserving ozone layer in the stratosphere, many kilometres above the earth, has been selected by authors Dotto and Schiff as the prime example to be identified in the 1970's.

In 1973, Sherry Rowland, an American chemist, hypothesized that fluorocarbon propellants from aerosol spray cans would eventually reach the stratosphere, then decompose in ultra-violet radiation and effectively destroy ozone molecules in a chemical reaction. The role which emissions from space and aircraft are suspected to play in this process is examined in the book, but it is the reaction of the scientific community, government and industry to Rowland's disclosure which is the main feature.

It is intriguing to see how scientists, forced to look at the stratosphere in earnest for the first time, appear very much like the fabled blind men grasping different parts of the elephant in their efforts to describe the problem to government. The actions of industry to discredit the findings are also noteworthy, as well as the selective, sometimes misleading, way that the media summarizes or head-lines scientific reports.

The book, in an attempt to provide all the details, is too long and lacks cohesion. However, the use of Sherry Rowland's activities as a theme helps unify the work, in spite of the massive welter of names and agencies mentioned throughout.
Book review by **Gordon W. Gee.**

Launching Mini-T-Sonde, for Temperature and Wind Observations in Lower Atmosphere.

U2A Wind Speed and Direction Measuring System – Toronto International Airport.