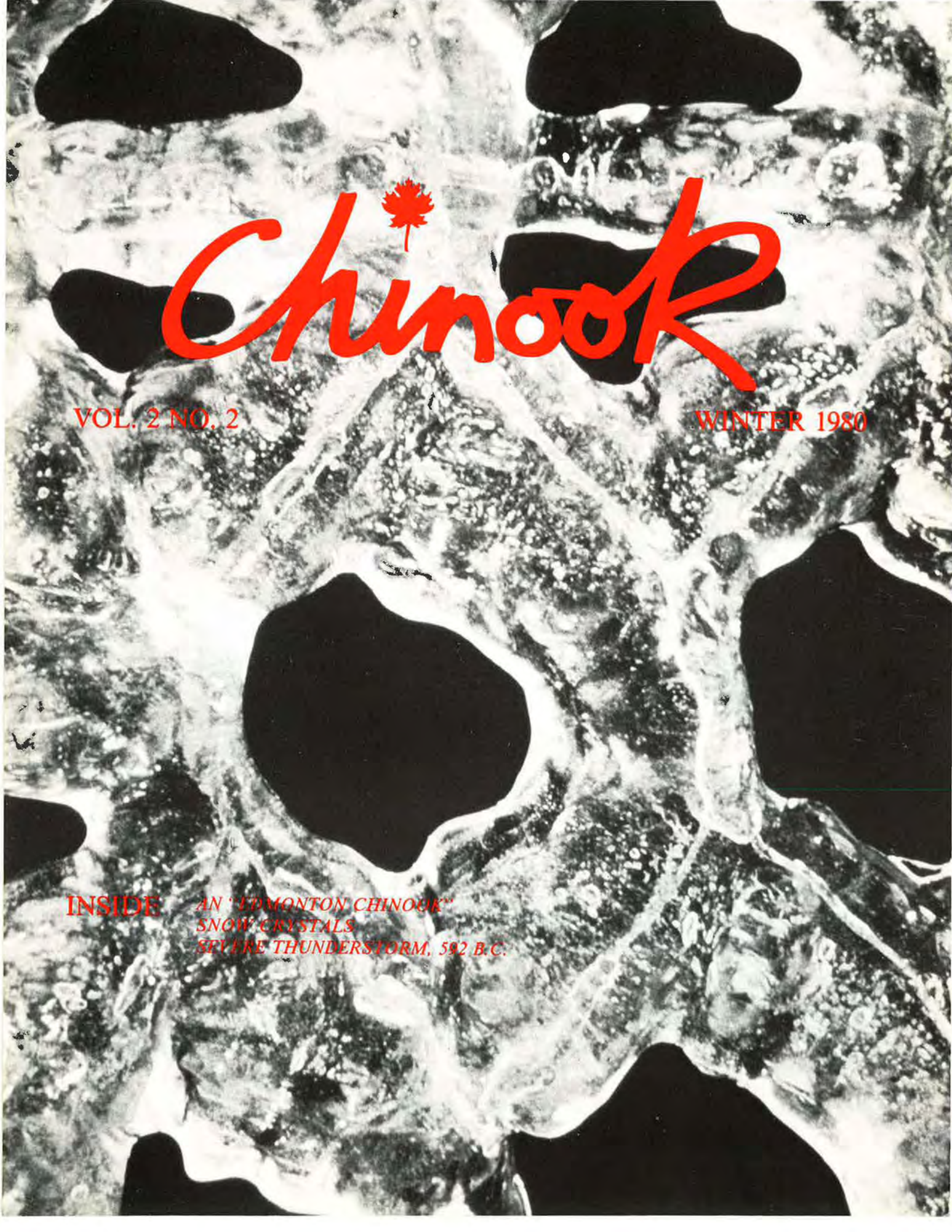

VOL. 2 NO. 2

WINTER 1980

INSIDE:

OUR APOLOGIES . . .

to **Enercorp** for the printing error which defaced their advertisement on page 14 of the Fall 1979 issue.

Chinook Winter 1980 Volume 2 Number 2

Articles

Departments

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THE COVER

A layer of clear ice 2.5 cm thick coats a wire fence. This product of heavy freezing rain, sometimes called a "silver thaw", is beautiful in the abstract but a nightmare in reality as it glazes roads, sidewalks, steps, wires and trees with a treacherous surface. The weight of ice on tree limbs is sufficient to break large branches, particularly when whipped by the wind, which fall causing secondary damage to whatever is below. Electric transmission wires, aerial telephone cables etc., are prone to "gallop" or resonate in harmony with the wind. The centre of the wire span rebounds up and down under its load of ice until either the wire snaps or the support poles are pulled down. Ice storms are a relatively common winter phenomena in eastern Canada and cause major disruptions to power supply, communication, travel and commerce.
Photo courtesy of A.E.S.

ONTARIO TORNADO MAKES NEWS IN HOLLAND

A friend of mine, who writes weather reports in more than ten newspapers and/or weekly distributed magazines here in Holland, has written an article about ***Chinook*** in *Trouw*. Last September he also wrote about the Woodstock tornado disaster and received many responses from people who were on holiday in Ontario during the summer, as well as from people who have relatives in Canada.

Weather is my hobby and as a volunteer for our Royal Dutch Meteorological Institute I also take regular weather observations every day. The instruments I use are: (a) an official aneroid barometer, (b) barograph, (c) hand anemometer, (d) a ventilated screen equipped with a thermograph, dry and wet bulb thermometers, maximum and minimum thermometers, (e) a rain guage, (f) a heated pluviograph for recording rainfall amount and duration, (g) six soil thermometers for measuring temperatures at 5, 10, 20, 30, 50 and 100 cm below the surface, and finally, because Marken is a small peninsula in Lake Yssel, I have a sea-water thermometer.

Jan Visser
Marken, The Netherlands

(Mr. Visser belongs to a group of weather amateurs who publish a journal called Weerspiegal. *It is in Dutch but some articles are summarized in English. Write to: Wim Brinksma, secretaris, Strausslaan 436, 2551 NK Den Haag, Holland. Ed)*

Here is a picture of the total solar eclipse at Winnipeg, Manitoba on February 26, 1979.

Wm. Brand
Toronto, Ontario

SEVERE STORM LOG

1979 ALMANAC EDITION

Hurricanes

Of the 8 storms of tropical origin during the 1979 hurricane season, only one — *David* — crossed Canadian territory (figure 1). Beginning as a tropical depression in 2000 km east of the Windward Islands on Sunday August 26th., it had matured into a major hurricane by the following morning. Rampaging through the Caribbean islands of Dominica, Puerto Rico and the Dominican Republic it was responsible for a total of more than 600 deaths, and left the majority of the people of the Dominican Republic homeless. Another 10 people perished as it swept northwards through the Atlantic coast states of the U.S. producing tornadoes, heavy rains, flooding and power blackouts. Shortly after making landfall near Savannah, Georgia, it weakened to a tropical storm (sustained winds less than 118 km/h). By late Thursday, September 6th., as Tropical Storm *David,* it had reached Fredericton, N.B., at which point it began accelerating and rapidly crossed the Gulf of St. Lawrence. Maximum wind gusts in excess of 100 km/h were reported at Grindstone Island as the storm passed. By early Friday afternoon, September 7th., as an extra-tropical depression, it had crossed the Great Northern Peninsula of Newfoundland to perish at sea in the North Atlantic shortly after.

By comparison with areas south of the border, Canada escaped with little effect. The heaviest rain fell in a narrow zone across the sparsely populated area of extreme northern New Brunswick and the southern portion of the Gaspé Peninsula. Charlo, N.B. reported 73.7 mm of rain, while Val d'Espoir (near Percé, P.Q.) received 122.8 mm. The *Honey Bee,* with five persons aboard, was reported missing in the Bay of Fundy after she transmitted a distress signal saying she was taking on water Thursday night. A search was mounted by a Canadian Coast Guard vessel and several fishing boats, as well as an aircraft from the Canadian Forces Base at Summerside, P.E.I. No trace of the ship was found and several weeks later there was still no news of her fate.

In Ontario, as the storm centre passed to the south on Thursday September 6th., a tornado was reported in the vicinity of Athens which levelled a farm silo, unroofed farm buildings and uprooted trees.

On the heels of *David* came *Frederic.* The path of this hurricane was further to the west, through the Gulf of Mexico, and as it approached Mobile, Alabama it was rated as a category 3 on the Saffir-Simpson Scale (where the top category of 5 represents a storm causing catastrophic damage). Considering its force, the U.S. death toll of 9 people was amazingly small. Hurricane *Camille* in 1969 for example, caused the death of hundreds. The reason for the difference was the speedy and safe evacuation of half-a-million people from the coastal areas of Florida, Alabama and Louisiana. *Frederic's* strength waned rapidly once reaching land early Thursday morning, September 13th. Its track was across Tennessee, where it dwindled to an extra-tropical storm, to its last identifiable position in New York state on September 14th.

Although *Frederic's* track did not enter Canada, the very heavy rain which accompanied it certainly did, and was responsible for the death of an 18 year old Quebec City man who was swept away by the flooded Duberger River when its soaked and softened bank crumbled beneath his feet. A swath from Welland and Fort Erie in the Niagara Peninsula, to Point Petre in Prince Edward County, to Kingston, Brockville, Morrisburg and Cornwall along the upper St. Lawrence Valley, was drenched by more than 100mm of rain. At Point Petre, 121mm was measured; at Kingston, 129mm; while Cornwall received 130.4mm, most of which fell in a 14 hour period on Friday, September 14th. Record one-day rainfalls were also reported at Montreal, P.Q., (81.9mm) and at Quebec City (81.2mm).

With much of the water running off into Lake Erie and Lake Ontario, the Canada Centre for Inland Waters measured a short-term rise of about 8 cm in the mean level of both lakes.

Throughout the area of the heaviest rainfall, storm drains culverts and sewers were overwhelmed. In some places the water gushed through manholes flooding streets and house basements. In Morrisburg, Ontario, where the older storm and sanitary sewers share the same conduit and are separated only by a one metre wall, the storm drain overflowed into the sanitary sewer forcing raw sewage back through the basement drains in a number of homes. Some residents of Fort Erie, Ontario, had to be rescued from their flooded homes by firemen in rowboats. In Quebec a few minor landslides occurred as the sodden soil slumped, and at Sherbrook, Quebec, trees were damaged by wind gusts of 75 km/h.

THE TRACKS OF *DAVID* (during the period September 1 to 7) AND *FREDERIC* (during the period September 4 to 14). Their location is shown at 0700 EDT each day. A and B indicate the hurricanes' positions in the photographs on the opposite page.

○ — — — ○ Tropical storm stage ○+++++○ Extratropical stage
○_____○ Hurricane stage ○ X X X X ○ Depression (dissipation) stage

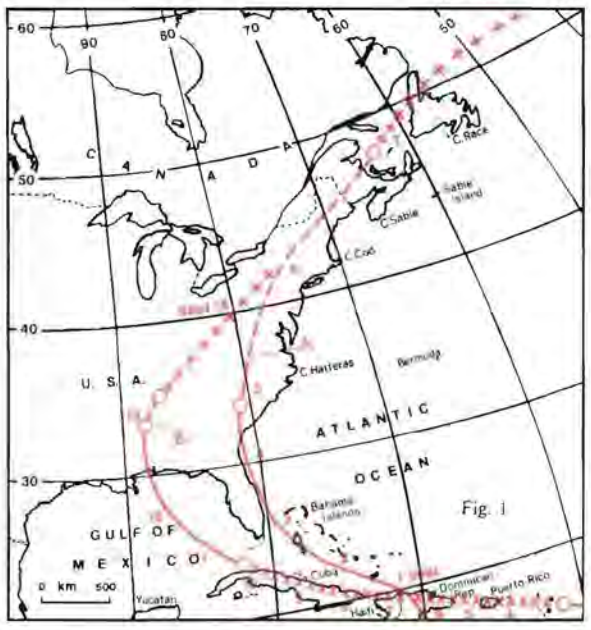


Fig. 1

Tornadoes

The 1979 tornado season began on Thursday April 5th., with the Leamington and Zurich areas of Ontario each subjected to a minor tornado. A total of at least 36 are known to have occurred across Canada (figure 2) at the cost of two people killed and thousands of millions of dollars in property damage before the season ended on Saturday September 6th., with a tornado near Athens (which was generated by the remains of hurricane *David*).

The two tornadoes near Woodstock, Ontario on August 7th., were easily the most severe storms of the season and have been described in detail in the Fall issue of ***Chinook***. On the Fujita Scale (ranging from F0 to F5 and representing the degree of severity) both tornadoes are classified as F4 with maximum wind strengths believed to be in the range of 330 to 416 km/h.

Of all the major population centres in Canada, Regina Saskatchewan was the most frequently hit by severe local storms during the year. A total of 3 tornadoes as well as a severe hailstorm struck within the city limits, with yet another tornado occurring nearby. Montreal, Quebec was next on the list with $1 million in property damage reported on June 10th., due to hail 2 or 3 cm in diameter, and also a tornado in the west end of the city on August 2nd. The most northerly known tornado of the season hit The Pas, Manitoba, on July 11th.

Waterspouts

Waterspouts were spotted early in 1979 when two were seen on March 5., at Prince Rupert, B.C. The last was observed in Lake Huron just off Goderich on October 5th. A total of 11 were reported in Canadian waters from such places as Northumberland Strait, the Great Lakes as well as the Pacific Coast.

Funnel Clouds

Funnel clouds (which are not tornadoes unless they touch the ground) were observed on 26 occasions from Labrador to Alberta.

Hail

The largest hail of the 1979 season fell near Waterford, Ontario in conjunction with the Woodstock tornadoes when hailstones as large as tennis balls pounded the tobacco crops of the area. Hail of a similar size also fell in Calgary, Alberta, on July 29th., where it combined with a flooding downpour to cause $322,000 damage. A young boy was very lucky to narrowly escape death after being swept by the torrent into a storm sewer. August 3rd., was indeed an unlucky Friday for southern Alberta which was raked by a series of devastating hailstorms.

Fatalities and Injuries

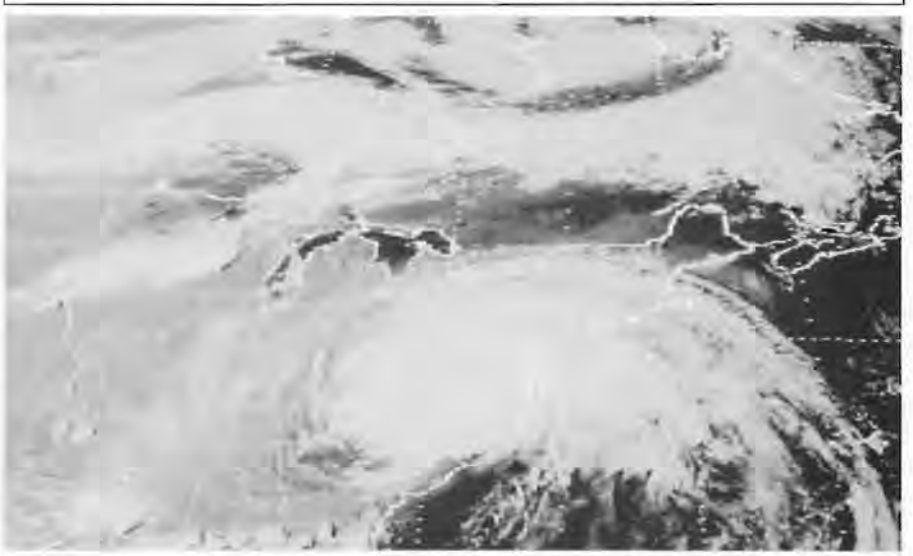
A total of at least 8 people were killed across Canada in 1979 by lightning, wind storms and tornadoes (not including deaths related to the large scale storms of the cold months of the year). In addition about 160 others were injured. One of the

cont'd p. 31

TORNADOES 1979

Fig. 2

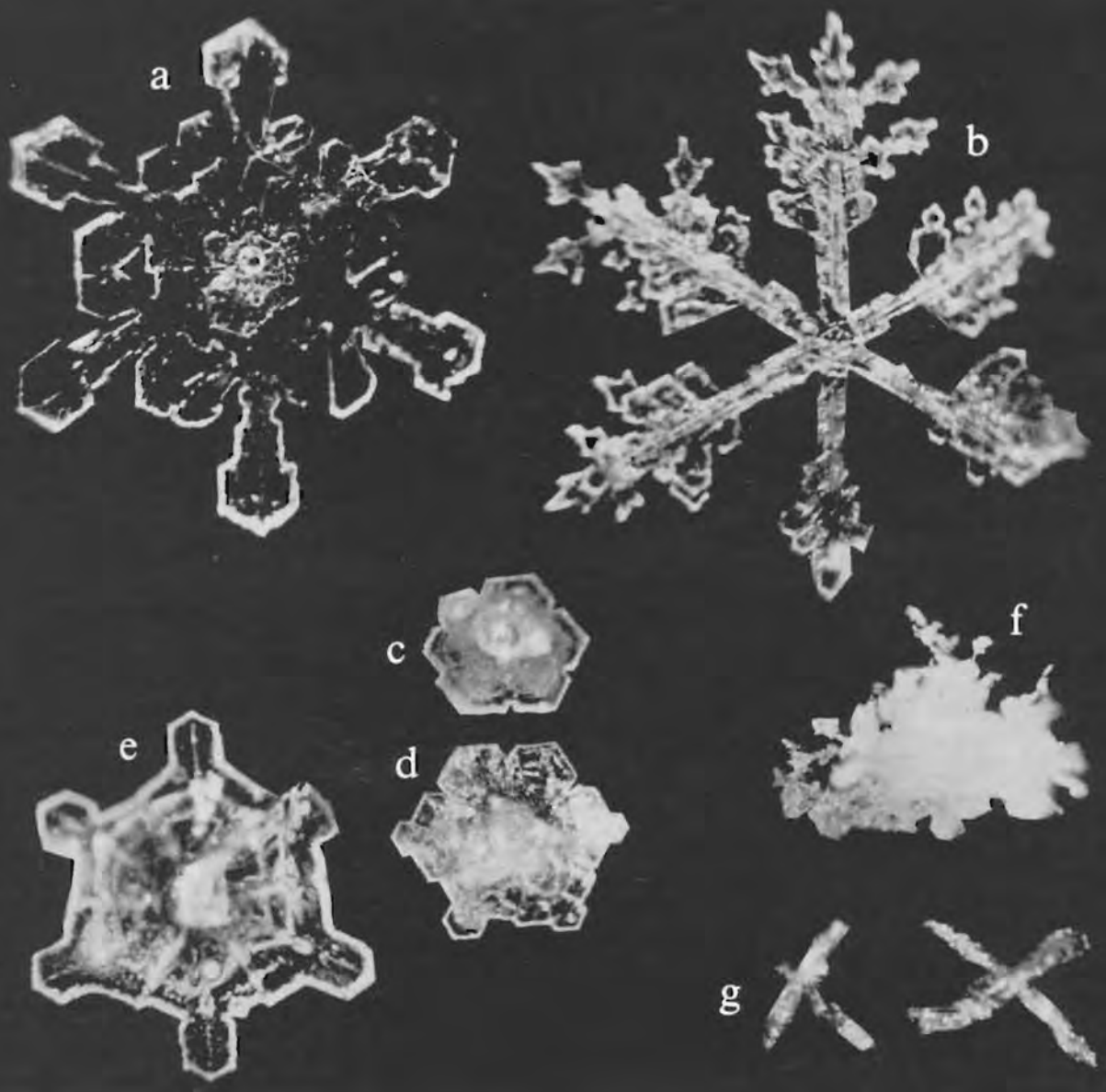
THE GEOGRAPHICAL DISTRIBUTION OF TORNADOES during the 1979 season. The number in parenthesis represents tornado deaths. The total amounts to 36, not all of which are confirmed due to lack of information. The first occurred on April 5th., and the last on September 6th. The number of tornadoes in 1979 was only 47% of the number which occurred during the previous 1978 season. * The information for Alberta was supplied by Prof. K.D. Hage of the University of Alberta.

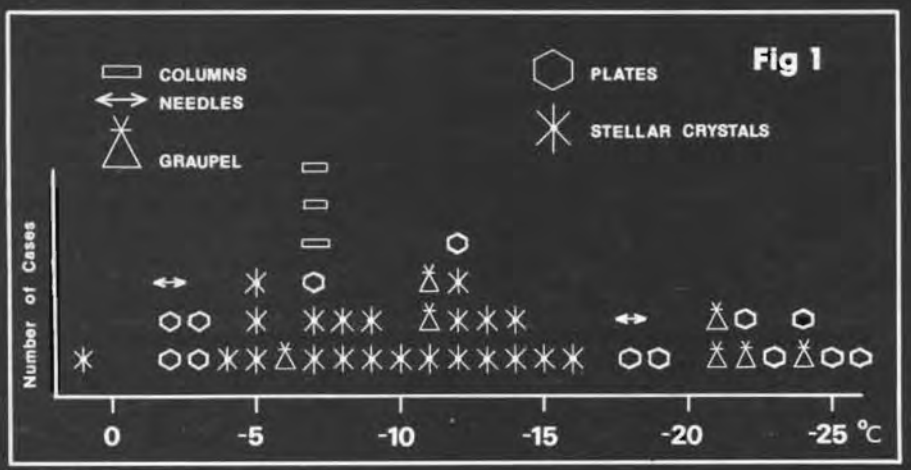


MIDDLE: *DAVID* PHOTOGRAPHED AT 1730 EDT, SEPTEMBER 5, 1979 by a geostationary weather satellite (GOES). By this time it was a tropical storm centred over North Carolina (location A in figure 1).

BOTTOM: *FREDERIC* AT 0900 EDT, SEPTEMBER 13, 1979 while it was still at hurricane strength over the Gulf states. (location B in figure 1).

Photos courtesy of A.E.S.





Above. Some of the snow crystal types which fell at Medicine Hat, Alberta during the winter of 1978-79. **a** Plane crystal with broad branches. **b** Plane crystal with fernlike branches. **c, d** and **e** Plates. **f** Graupel pellet. **g** Needles.

Left. Relationship between crystal types and the air temperature at ground level when they fell. It is evident that this is not a simple relationship. It has been found[2] however that there is a much closer link between the crystal types and the temperature of the air at the level of the atmosphere where they are formed.

SNOW CRYSTALS

Contributed by Donald Netolitzky

Once again the work of a 1979 Canada-Wide Science Fair finalist is presented in this weather amateur column, specifically the prize winning efforts of **Donald Netolitzky,** 13, from Medicine Hat, Alberta. His project spanned a period of about seven winter months during 1978-79 and was inspired by the book *Field Guide to Snow Crystals* by Edward R. LaChapelle[1].

Donald Netolitzky at his Canada-Wide Science Fair exhibit.

The extraordinarily symmetric nature of the six branches of a snow crystal has long been an object of wonder and mystery. The first sketch of snow crystals observed with the naked eye was made by Olaus Magnus, the Archbishop of Uppsala, about 1550, although it did not indicate their hexagonal symmetry. It was Kepler who first pointed out that fact. Sketches made by Descartes in 1635 and published in Amsterdam, are thought to be the first scientific records of snow crystals. After the invention of the microscope in the latter half of the 17th., century, minute observation of nature made rapid progress, and Robert Hooke in his 1665 publication *Micrographia* presented the first accurate detailed sketches.

Perhaps there has been no more patient and ardent student of snow crystals than W.A. Bentley of Jericho, Vermont, who spent half a century recording their hundreds of forms all based on the common hexagonal pattern.

The common problem faced by all researchers is the snow crystal's fragility. It will evanesce at the faintest breath and quickly melt away when exposed to the radiated heat from the human body. Even at temperatures below freezing it will sublimate. A common solution to this problem is to conduct investigations in a special cold room where the crystal's life can be prolonged and studies made of such physical properties as crystal structure, size and mass; the falling velocity; riming due to cloud droplets; and electrical characteristics.

Donald Netolitzky's method of snow crystal collection was to place a square of black felt material outside long enough to catch a small sample of the snowfall. The catch was then sprayed with Krylon, a clear acrylic paint. It is important to ensure that both the felt and the paint are at the outside temperature in order to avoid melting the delicate crystals. The sprayed crystals were left outside in a sheltered place for two or three hours to allow the paint to dry during which time the crystals themselves sublimated leaving only the acrylic replicas. Immediately after each catch the air temperature was recorded because the purpose of the experiment was to determine the relationship, if any, between crystal types and the temperature at which they fell.

When the Krylon had set, the replicas were brought indoors for identification, classification, microscopic analysis and photography. For the amateur, this collection method has the considerable advantage of preserving the crystals and enabling the actual study and photography to be done in indoor comfort, but at the price of losing the detail of the real crystal. However, as the photographs (opposite page) indicate, a fair amount of detail can be retained, and certainly there is no difficulty in identifying the crystal type according to the International Snow Classification.[1] The photographs were obtained by attaching a 35 mm camera body to a microscope set at 18 power. Tri-X film was exposed in the camera for $\frac{1}{30}$th to $\frac{1}{15}$th., of a second, with the exposure determined by trial and error.

During the period of observation, 43 snowfalls were investigated. The most common crystal type was the stellar variety, and indeed planar crystals (stars and plates) predominated at all temperatures (see Fig. 1). Needle-like crystals (needles, columns and bullets) were seen more rarely and fell at temperatures of -2°C, -7°C and -18°C. Graupel pellets were observed with temperatures of -6°C, -11°C, and from -21°C to -26°C. Once, rimed crystals were found. These are crystals with numerous frozen water droplets attached which are really super-cooled cloud particles collected by the crystal as it falls. Researchers have measured the rime particles attached in this way and typically they are about 0.03 mm in diameter. Actually, it is not the temperature at ground level which determines the crystal form, but rather the conditions of temperature and supersaturation of moisture at the level in the atmosphere where they develop. Investigating this aspect is well beyond the scope of simple experimentation.

Further Reading

Bentley, W.A., and Humphreys, W.J. 1962: **Snow Crystals.** New Dover edition, Dover Publications Inc., New York, N.Y.

Knight, Charles and Nancy. 1973: **Snow Crystals.** *Scientific American,* Vol. 228, No. 1, pp 100-107.

[1]LaChapelle, Edward R. **Field Guide to Snow Crystals.** J.J. Douglas Ltd, Vancouver, B.C.

[2]Nakaya Ukichiro. 1954: **Snow Crystals: Natural and Artificial.** Harvard University Press, Cambridge, Mass.

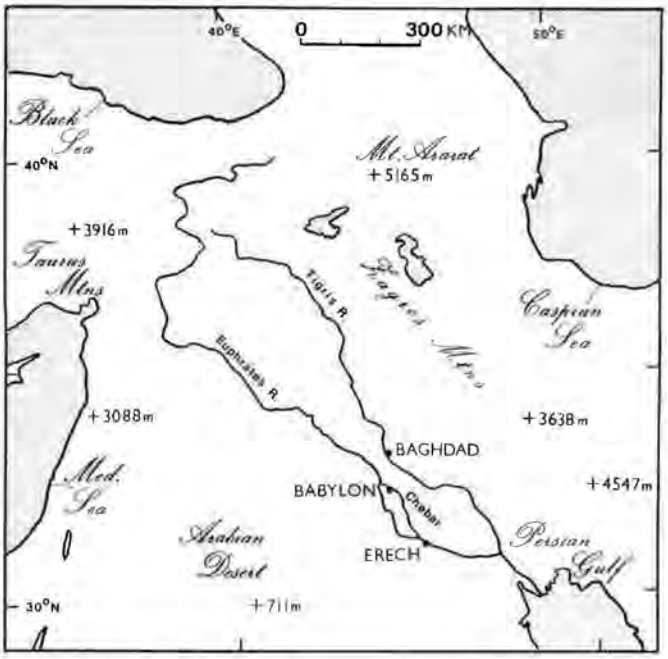

DAVID R. WICK '79

SEVERE THUNDERSTORM, 592 B.C.

AN EYE-WITNESS ACCOUNT

by A.F. Davies

On July 21, 592 B.C. (or July 1, 593 B.C. by an alternative calendar) a severe thunderstorm was observed in the vicinity of a canal named "Naru Kabiri" or "Chebar" at that time. Today this canal is known as "Shatt ennil." It ran from the Euphrates river, northwest of the city of Babylon, southeastward through Kish and Nippur, to re-enter the Euphrates again near Erech, a total distance of 160 kilometres.



Geographically this region bear some similarity to "Tornado Alley" in North America. To the west, southwest, and south is a vast, 1000 kilometre by 3000 kilometre, generally elevated area (up to 1000 metre altitude), of desert and occasionally mountainous terrain. To the southeast is the Persian Gulf, whose warm waters are an extension of the Arabian Sea. Running from the northwest to the southeast are the broad, sometimes swampy, lowlands of the Euphrates and Tigris rivers. These flats cover an area 1000 kilometres in length, and 300 kilometres in width. The severe thunderstorm, with which we are concerned, occurred at the geographical centre (see map) of these lowlands southeast of Baghdad in modern Iraq.

Bounding the lowlands on the east, north, and northwest, are the formidable mountain barriers of the Zagros chain (3500-4000 metres elevation), Mt. Ararat rising to 5200 metres, and the Taurus mountains of Armenia, Cilicia, or modern southeastern Turkey.

Based upon several independent methods of investigation, it has been concluded by climatologists that the "normal" pressure distribution, in the middle east around the date of this occurrence, showed a low pressure centre in the vicinity of the Persian Gulf, with a northerly circulation from the Caucasus mountains towards the Arabian desert, and a ridge of high pressure extending from modern Italy toward the Sudan.

The normal mean sea level pressure at the observation site would have been about 100.2 kilopascals, some 0.3 kilopascals lower than in the southern United States in July today. Maximum surface temperatures would have been in the range 35°C to 45°C, about 5°C higher than in the southern states. In the case of the reported severe thunderstorm, we can conclude that the mean sea level pressure was probably 100.0 kilopascals or lower, and the surface temperatures 35°C or higher.

In the upper atmosphere, there would normally be a southwesterly flow from a trough over the eastern Mediterranean to a weak ridge located east of the Caspian Sea. The normal 30.0 kilopascal height would have been about 9750 metres. The high level jet stream would have normally run from Sicily to the southern Black Sea and northern Caspian, about 1200 kilometres to the northwest of the observation site. The normal 30.0 kilopascal temperature was about -27°C, some 7°C higher than in the southern states today. The normal 100 to 50 kilopascal thickness would have been about 5800 metres.

In summary, the geographical, seasonal, and meteorological conditions at the location from which the eyewitness account came, were similar to those existing in the parts of North America where severe storms and tornadoes are most frequent. The latitude corresponds to that of Dallas, Oklahoma City or Little Rock. The 500 to 1000 metre elevations in the Arabian desert correspond to those in western Kansas, Oklahoma and Texas, while the elevations around Mt. Ararat, and to the west, are similar to those in western Colorado and Wyoming. Maximum surface temperatures and normal 30 kilopascal temperatures were both about 5°C to 7°C higher than in Oklahoma and Texas today. There was an abundant low level moisture source in rivers, swamps, and the Persian Gulf. Occasional outbreaks of air which was about 10°C cooler than that in the river valley could occur. The construction of a possible tephigram representing these circumstances indicates that the development of Cumulonimbus clouds with tops near 15 kilometres would be possible. Severe thunderstorms do occur in this area today, although usually earlier or later in the year. For instance, an aircraft en route from Amman to Muscat (about 500 kilometres south of the location of the storm of 592 B.C.) was struck by lightning, killing 45 persons, on March 14, 1979.

Turning now to the account (in Ezekiel Chapter 1) and remembering that the writer was a religious leader using the knowledge, language and terminology of 2500 years ago, how was the event reported?

The account begins with the sighting, to the north, of a "great cloud," accompanied by a "whirlwind" which was lit up internally by frequent "flashes of light-

ning," so that it appeared to be "on fire." The colour of the cloud, in that part where the "fire" was seen, was described as "the colour of amber," that is to say, somewhere between yellow and brown.

Extending downward from this same part of the cloud were four "straight" appendages which were so active that they were described as being "living creatures." Where they touched the ground they were shaped like "a calf's foot." These appendages were "sparkling" with the colour of burnished brass. There were flashes of lightning amongst them like burning coals or lamps. These flashes were very bright, and there were strokes of lightning repeatedly coming from them.

The appendages displayed several motions. Externally, they moved straight ahead, in the direction of motion of the great cloud itself. However, their motion continually appeared to reverse, as they "sped back and forth." Internally, they were rotating as though there was a "wheel in the middle of a wheel." Where they touched the ground there was a rotation "like a wheel." From time to time they would be lifted up from the ground, and the rotating tips would be lifted up as well.

The appendages were surmounted by elements which the writer described as looking like faces, of humans, lions, oxen and eagles. Above them were "rings" which were "so high that they were dreadful" and "their rings were full of eyes round about them four." Above the rings there was a great expanse of cloud "sparkling like ice and awesome." Still higher there was a formation which looked like a throne of sapphire, that is to say it had a transparent blue appearance. Finally Ezekiel discerned a human like figure, like glowing metal, full of fire, surrounded by a brilliant light which was like a rainbow in the clouds on a rainy day.

Finally, there was a tremendous roar which Ezekiel described as like a waterfall, or rushing rapids in a river, or like the tumultuous noise of an army in battle. As he fell flat on the ground he heard a great rushing noise like voices shouting, like great wings rustling, like many wheels spinning.

Ezekiel was so shaken by his experience that it was a week before he could begin to speak. "I . . . remained there astonished among them (the Jewish captives at Telabib by the river Chebar) seven days."

As a religious man, in the presence of one of the rarely seen wonders of our world, Ezekiel had a spiritual experience in which he committed himself to speak to his people on behalf of the Creator who had brought this phenomenon into existence. Whether or not a similar vision would awaken the same emotions and reactions today, there can be little doubt that Ezekiel, in 593 B.C. or 592 B.C., saw the same type of phenomena that observers of tornadoes see today. The great billowing cloud, brilliantly illuminated above, dark and ominous below, was similar to those seen and photographed today. What he saw were fearsome funnels reaching down out of rotating curtains of cloud and precipitation, touching the ground with whirlwinds demolishing all in their path, alternatively lifting and lowering, occasionally pausing, then moving swiftly straight ahead, all common characteristics of present day tornadoes. He had never experienced the noise of a freight train speeding by, but there is little doubt that he heard the same noise reported by eyewitnesses today.

This may be the earliest written account of such a phenomenon. Whether or not this claim can be made for it, there is no doubt that even though he was limited by the lack of the training and specialized terminology we employ today, Ezekiel has given us one of the most vivid descriptions of a tornado producing storm ever written.

BOOK REVIEW

by John L. Knox

HURRICANE HAZEL by Betty Kennedy. Macmillan of Canada, Toronto 1979. Hardcover, 176 pages. $14.95.

Twenty-five years ago, October 15, 1954, the storm Hazel swept northward across Lake Ontario and caused unprecendented downpours over already saturated watersheds of Metro Toronto and surrounding areas. The stark statistics of the subsequent tragedy were 81 dead, 3,700 homeless, and $25,000,000 damage. Betty Kennedy has provided a fascinating account of this disaster in terms of the personal experiences of those involved at the time.

The setting for the story is skillfully developed by recalling contemporary world events, and the moods and preoccupations of Toronto in 1954. (The City went 'bananas' that summer when 16 year old Marilyn Bell swam Lake Ontario).

Some sense of the drama of the Malton Forecast Office's role is also conveyed, although this reviewer disagrees with author Kennedy's suggestion that the warnings (of gale force winds and steady rain) were "low key". The weather warnings, (one of which is paraphrased in the book), were forthright, timely, and accurate, but unfortunately they did not elicit the response from some agencies and individuals which they warranted. At that time the Province of Ontario did not have an effective system for translating the weather warnings into riverflow potential and flood crest probability.

One puzzling feature of the book is the last chapter — "Three Stories" — a triumvirate of eyewitness accounts which the author could well have included with the central chapters. As for current-day Toronto Institutions, human and otherwise, (p. 156) her promotion of Gordon Sinclair to King of Broadcasters may not meet with coast-to-coast unanimity.

There were lessons to be learned from the disaster and the author provides a lucid account of the creation by 1957 of the Metro Toronto and Region (Conservation Authority, its functions and subsequent achievements. Streams are now well guaged, river warning systems are in place, and flood-prone valley flats have been converted into recreation and conservation areas.

In Chapter 14 it is made clear that the visit of another Hazel-type storm to southern Ontario is entirely possible, although the effects in the Metro Toronto area, at least, will be greatly mitigated. Of course these weather systems are not templates of their predecessors, so that scenarios for future Hazel-type storms should include all the watersheds of the Lower Lakes.

I enjoyed reading "Hurricane Hazel" and recommend it to readers of ***Chinook***.

"BLACK STRATUS" by Oscar Koren

WINDOW ON WEATHER

During the long winter months the snow and ice covered areas of northern Canada become extremely cold due to the absence of sunshine and the loss of heat from the ground through outgoing long wave radiation. Frequently, the air temperature a few hundred meters above ground can be as much as 20°C warmer than it is at the surface. This increase of temperature with height is normally referred to as the temperature inversion. The existence of temperature inversions is frequently inferred from infrared satellite pictures, however, only those familiar with satellite photo interpretation can recognize them. This example will help others to identify them, too.

The photo shows the infrared satellite picture taken on February 23, 1978 at 1523 GMT. Different gray shades are related to different temperatures. Light shades denote cold temperatures and dark shades are associated with warm temperatures. The feature of interest in the picture is the band of cloud stretching over Hudson Bay from north to south (AB) in an otherwise clear sky. Examining it we see that the west side of the band appears darker than the east side and, in addition there are a few even brighter streaks within the lighter portion of the band near the eastern edge. We interpret the brightest streaks as high clouds (cirrus) with very cold cloud top temperatures. The slightly grayer part of the cloud band is interpreted as mid-level cloud (altostratus) with somewhat warmer cloud tops, and the dark cloud along the west side of the band is interpreted as low cloud (stratus) with relatively warm cloud top temperature. Typically, when inversion conditions exist, the stratus which is trapped beneath the warm air appears dark and has become known as "black stratus". We also note that the ice and snow covered surface of Hudson Bay and James Bay has approximately the same gray shade (that means approximately the same temperature) as the tops of the middle clouds.

From this analysis we see that the cloud top temperature of the low cloud is significantly warmer than the temperature at the snow surface which indicates the presence of a temperature inversion. In practice the presence of temperature inversions in the atmosphere is determined by analysing the temperature vs height diagrams on which temperature measurements from radiosondes are plotted. In Canada, the most commonly used diagram for this purpose is the tephigram. Figure 1 shows the temperature measurements obtained by a balloon-borne radiosonde instrument launched at Churchill, Manitoba about 3 hours before the photograph was taken. The temperature at the earth's surface was –18°C whereas the temperature at the top of the stratus layer was only –4°C. Further analysis shows an inversion (increase of temperature with height) between 50m and 600m. The layer between 600m and 1500m was nearly isothermal (no change in temperature with height), whereas above 1500 m the temperature was decreasing with height.

It is also observed that at the height of 4200 m the temperature of the air was the same as at the surface. Since the middle clouds on the satellite picture have about the same gray shade as the snow surface it may be concluded that the tops of the middle clouds were at approximately the 4200 m level.

Satellite photo interpretation is fast becoming a new science, and recognition of temperature inversions on the satellite pictures is only one of many meteorological applications.

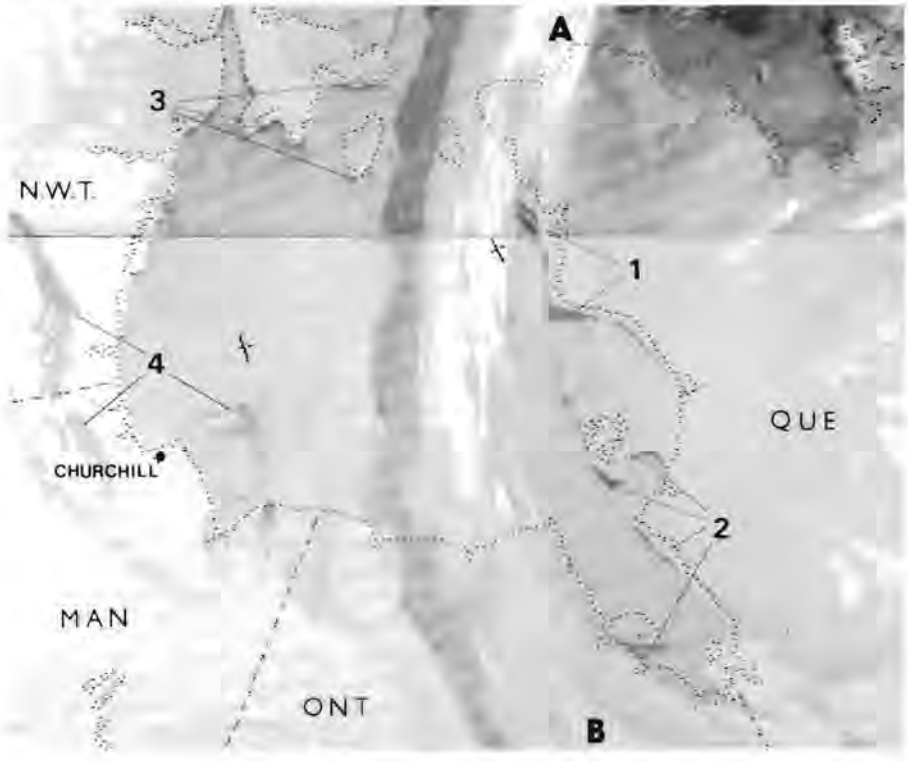


PHOTO. INFRARED SATELLITE PICTURE taken by the NOAA5 Satellite on February 12, 1978 at 1523 GMT. Besides revealing a temperature inversion (discussed in the text) there are other features of interest in the picture. The marked difference in the gray shade between snow covered Hudson Bay and the adjacent snow covered land areas suggest that Hudson Bay is a heat source in winter time. Secondly, the presence of open leads (1, 2, 3) along the southern edges of the coastline suggest the existence of northerly winds. Finally, patches of black stratus (4) associated with temperature inversions can be seen over northern Manitoba, southwestern Hudson Bay and over the Northwest Territories just to the west of Hudson Bay.

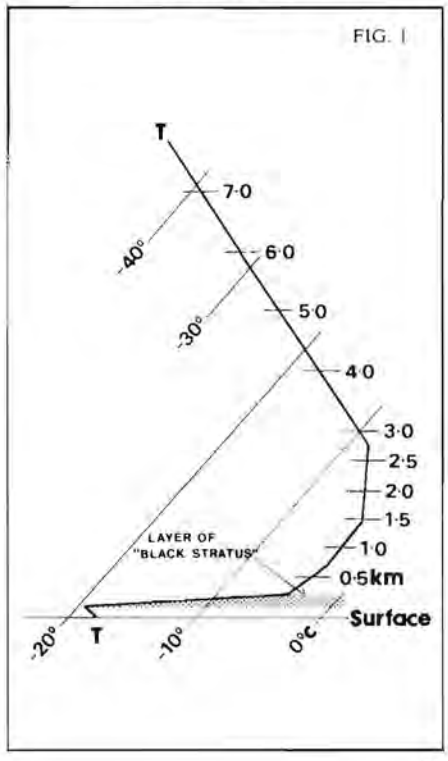
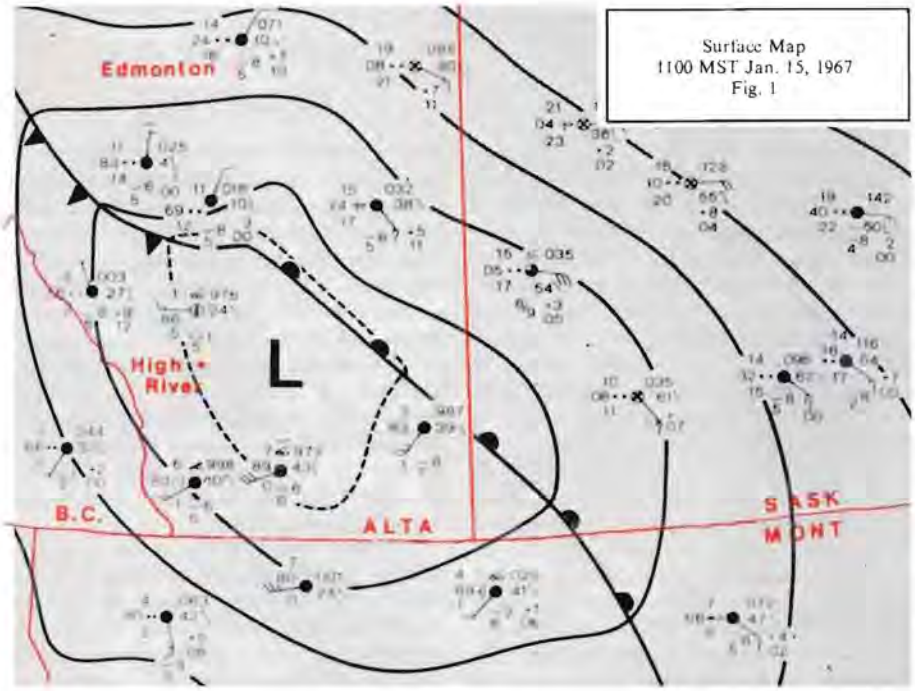


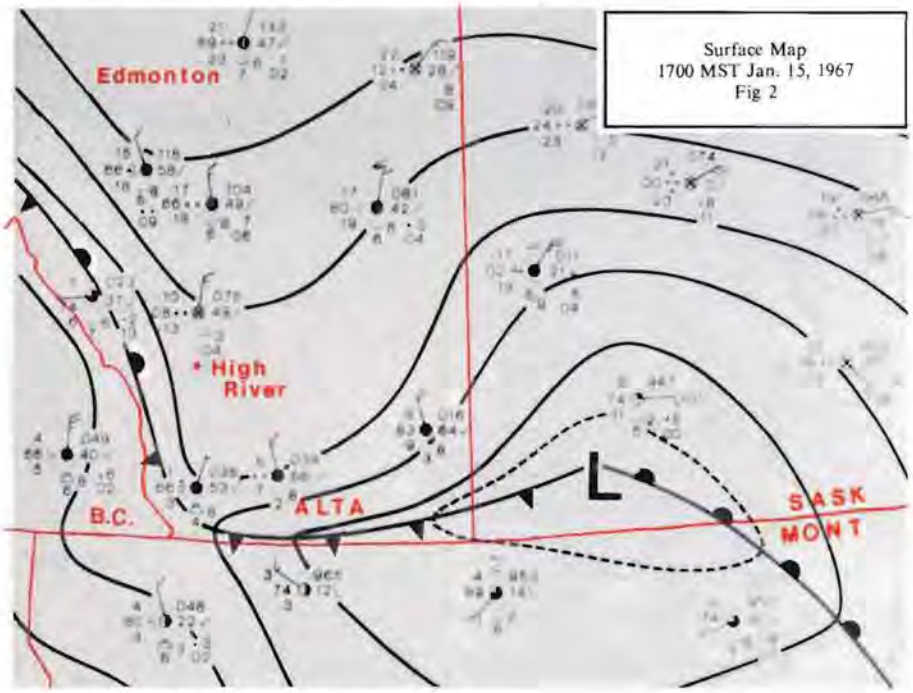
FIGURE 1. THE CHANGE OF TEMPERATURE (T) WITH HEIGHT plotted on a tephigram for Churchill, Manitoba, February 12, 1978, 1200 GMT.



Surface Map
1100 MST Jan. 15, 1967
Fig. 1

AN "EDMONTON CHINOOK"

by Keith D. Hage



Surface Map
1700 MST Jan. 15, 1967
Fig 2

Legend has it that Chinook Wind is the beautiful but blind daughter of South Wind who frequently leaves her home on the east slopes of the Rockies and follows the valleys eastward in search of her father who was carried away by North Wind. Her blindness is no disadvantage because North Wind usually arrives swiftly and without visual warning. However, in certain special circumstances North Wind comes dressed in black fury or in white splendour as shown in the spectacular photographs (opposite page) by Mr. A.G. Hedlund of Cayley, Alberta, which were taken near High River, Alberta at 1400 MST on January 15, 1967. Light snow cover raised by the wind combined with clouds and snow showers to produce a menacing white mound of weather.

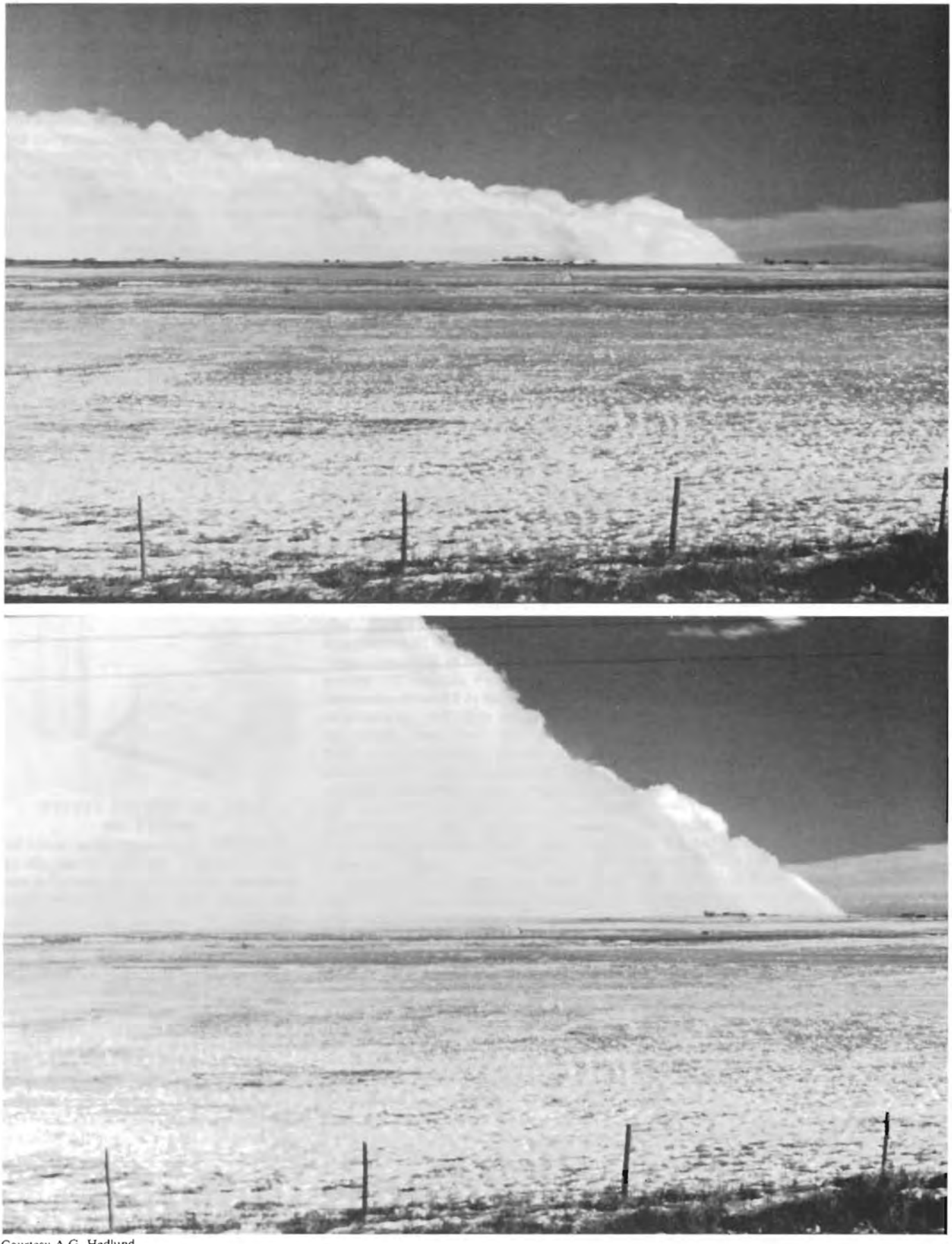
Figures 1 and 2 illustrate surface weather maps for southern Alberta at 1100 MST and 1700 MST on January 15. A sharply defined cold front arrived at Calgary from the north at 1257 MST accompanied by snow and blowing snow, gusty north winds, and an abrupt drop in temperature from +6°C to -8°C. The front arrived at Lethbridge in much the same fashion at 1542 MST, then continued into the northern plains states with blizzard conditions reported in southern Saskatchewan, North Dakota, and Minnesota. The frigid arctic air mass behind the front established new daily minimum temperature records at many places including a reading of -44°C on January 18 at White River, Ontario.

In Calgary, gusts to 86 km/h at the time of frontal passage resulted in thousands of dollars in building damages according to the Calgary Herald of January 16. More wind damage, including trucks blown off highways, was reported in the midwest as the front passed.

The black fury of North Wind is rare now but was a common occurrence in the 1930s and early 1940s in southern Alberta. The approaching "black blizzards" of spring and fall, laden with dust rather than snow, were every bit as fearsome as their winter counterparts.

It is likely that many factors contribute to the unusual vigour and spectacle of such cold fronts in this region. In the first place dry cloud-free air of the "sunny south" ahead of the cold front reinforces the visual contrast in air masses. Southward moving air is forced to rise some 450 metres between Edmonton and Calgary and it must accelerate in the narrowing channel between the storm centre and the Rocky Mountains.

PHOTOS OPPOSITE. AN ONRUSHING ARCTIC AIRMASS sweeps across fields near High River, Alberta, in these pictures taken just moments apart. The phenomena was located along the cold front depicted in the maps to the left.



Courtesy A.G. Hedlund

TRADE WINDS

EDITOR'S WELCOME ...

Welcome to the inaugural page of TRADE WINDS. I am pleased to have become associated with ***Chinook*** magazine in attempting to offer a forum of exchange for the "weather" section of the Canadian business community. Up until now, there has been no proper vehicle for this type of communication, yet there is a strong need not only for the meteorological/oceanographical industry to be exchanging information but also for teachers and researchers to be kept aware of the activities of their meteorological service industry (equipment manufacturers and suppliers as well as consultants).

Beyond this initial and main purpose, TRADE WINDS will also at times, act as a debate platform to discuss views and opinions which are of importance to the "met/ocean" community. The first issue introduces this other aspect of TRADE WINDS by presenting a topic which presently affects provincial and federal researchers but also indirectly is of concern to all Canadian taxpayers.

The success of TRADE WINDS lies with you the reader, whether you are a graduate student struggling with a new sensor design, or the president of a Canadian meteorological supply and service company. My only role is to coordinate your information and to decide on the content of the page. You now have a standing invitation to contribute news and views to TRADE WINDS. We want to hear about new sensors, equipment, designs and service. We also want to hear about measurement problems, new consulting services, research activities, meetings and trade shows or exhibitions. But particularly we welcome your opinions and comments because the content and format of TRADE WINDS has to grow and change to continuously satisfy the information needs of the "weather" industry.

VIEWPOINT ...

During my sales travels and meetings with federal and provincial researchers, I have come across a situation which seems designed to make "environmental" research in Canada more expensive through increased bureaucracy. I am presenting this topic for discussion since there seems to be no organized movement to change a new and potentially damaging government policy.

I refer specifically to the change in government operations whereby some federal and provincial agencies are now subjected to import duties. Agriculture Canada is an example of a government agency which has to pay an extra 7.5 to 17.5% (and in some cases more) for equipment being brought into the country from foreign sources. These agencies were in the past, exempt from import duties and federal sales tax. In this customs re-classification, all agencies affected have to increase their budgets to handle these costs. Furthermore customs brokers have to be consulted to handle this new situation. These extra costs simply go from one section of the government (the research institute) to another (customs and excise), and we as taxpayers must pay for them.

If the purpose of the ruling was to protect Canadian manufacturers from foreign imports, why was the decision so general in nature as a re-classification? Would it not have been more useful to simply charge import duties on items which are available in Canada? Universities and other specific institutes are still exempt so why must federal and provincial agencies be treated in this fashion? Is this a genuine problem or are the researchers affected not concerned by these increased and imposed costs? Your views please.

cont'd. p. 31

NEW PRODUCTS

CR21 MICROLOGGER

Campbell Scientific Inc. of Logan Utah, recently introduced the CR21 Micrologger as the newest addition to their data logger family. Powered by 8 alkaline "D" cells, it inputs data from up to 9 sensors, processes that information according to programs selected by the user and stores the processed data in its own memory. Data retrieval methods for the CR21 include cassette tape, printer, telephone dial-up, and LCD display. Using the keyboard, the operator selects the type of input signal conditioning to be done on each sensor (AC conductivity, DC ohms, volts, millivolts, pulse counting). Sensor characteristics can be incorporated such that the final values given are in engineering units. The final data processing routines for incoming data, and the data storage or transfer medium are also selected by the user from the keyboard which includes averaging, standard deviation, and histograms among other functions. The unit is packaged in a 7.6 cm x 15.2 cm x 20.3 cm aluminum case. Battery life is typically three to six months. The CR21 Micrologger is designed for use in remote environmental monitoring, agricultural research, and field engineering studies. Its price and telecommunication capability make it ideal for network data acquisition. Available in Canada through **Campbell Scientific Canada,** 10429 87 Ave., Edmonton, Alberta. T6E 2P4. (403) 439-2771.

V.H.F. TELEMETRY SYSTEM MODEL 500

The V.H.F. Telemetry system Model 500 is a real time R.F. data link for use with an **Aanderaa** weather station, current meter, tide gauge data logger or hydrophone receiver.

The transmitter is designed to connect directly to the **Aanderaa's** equipment output terminal. The receiver decodes the data and outputs it in a form identical to the original **Aanderaa** format.

The transmitter is housed in a rugged aluminum pressure case. The antenna assembly is removeable to permit subsurface mooring or remote antenna placement. The receiver incorporates a high quality crystal controlled dual conversion receiver. Power is supplied by either internal batteries or 110/220 VAC. An audio monitor provides a quick data check.

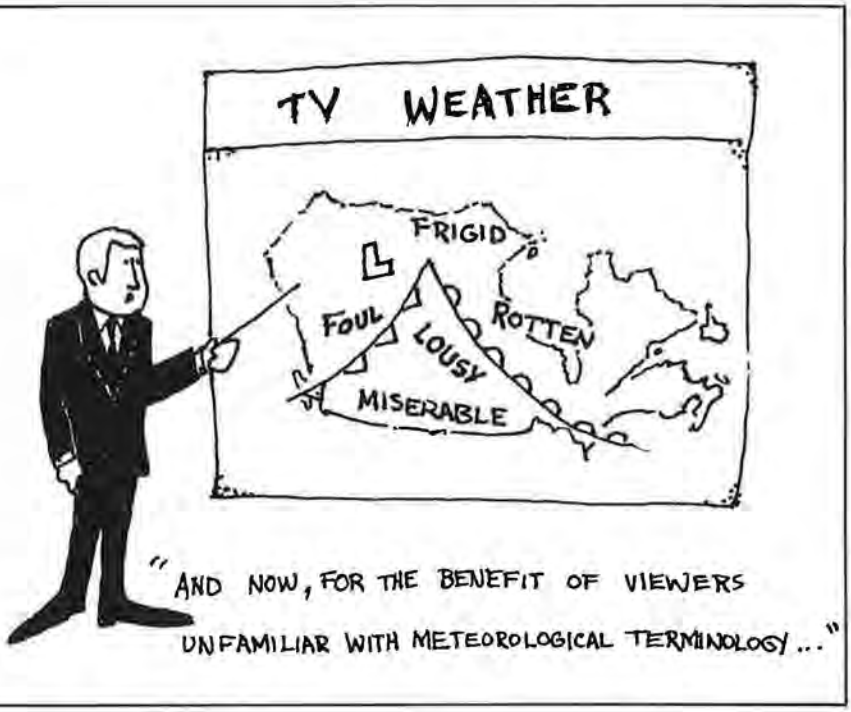
For information contact **NOVATECH DESIGNS LTD.** 822 Cormorant St. Victoria, B.C. V8W 1R1, (604) 381-1211.

cont'd from p. 30

Claude Labine

ABOUT THE
TRADE WINDS EDITOR ...

Claude Labine originally was a student of biology and ecology. After obtaining a B.Sc. degree from Laurentian University, he became involved with the Tundra Biome Project, a part of the International Biological Programme on Devon Island, N.W.T. This caused him to shift his studies to microclimatology and he obtained an M.Sc. from the University of Guelph. Since then he has been involved in a research project with the Alberta Oil Sands Environmental Research Programme and has been a sessional lecturer in the Geography Department at the University of Alberta. Mr. Labine has recently joined the "weather" business community by becoming the Canadian representative for **Campbell Scientific** of Logan, Utah.



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most unusual incidents of the year was perhaps caused by a strong dust-devil. On April 11th., a nurse with many years of driving experience was driving north from Peterborough, Ontario along a paved road flanked on either side by wide-open fields. It was a bright sunny and very dry day with the air temperature about 5°C and the relative humidity about 30%. A large area of high atmospheric pressure was centered over the region. In an interview with ***Chinook,*** the lady recounted how that suddenly and inexplicably her small car was lifted first onto the two wheels of one side and then onto the two wheels of the other. She collided with an oncoming van and was very badly injured in the crash. Traffic was very light, and she recalled that there was no apparent wind and that she was feeling well and fit. Agents for the insurance company checked her car thoroughly and could find no mechanical defects that would contribute to the accident.

In our opinion a powerful dust-devil careening across the road could have been the culprit. The meteorological and topographical conditions were conducive to such a phenomena, and a road accident caused by a dust-devil is not without precedent (*Journal of Meteorology,* Sept 1976, p 358). With a typical lifetime of only a few minutes, the dust-devil would have quickly dissipated leaving no clues to its existence and posing an enigma for the accident investigators. Do you have any other explanations?

ANSWERS TO ARCH PUZZLES 6 AND 7, FALL 1979

6 Brown tie and green suit

	Mr. Green	Mr. Blue	Mr. Black	Mr. Brown	Mr. Grey
Tie	blue	black	brown	grey	green
Suit	brown	grey	green	blue	black

7

B.C.	Abco Mountain, Crab Creek, Crab Cove, Job Creek
ALTA.	Gibraltar Mountain, Gibraltar Rock
SASK.	Saskatoon, Alsask
MAN.	Manitou, Manson
ONT.	Toronto, Almonte, Avonton, Belmont, Claremont, Deseronto
QUE.	Quebec, Duparquet, Les Becquets, Ste Angelique, St Dominique, St Jacques, Ste Veronique, St Zotique
N.B.	Cranberry Point
N.S.	St Ann's, Canso
NFLD.	none. NF. Twin Falls
P.E.I.	none. PE. Perth, Peaks, Peterville, Cascumpeque
N.W.T.	none. NW. Norman Wells
Y.T.	none. YT. Lynx City

CALENDAR OF SHOWS, EXHIBITIONS AND CONVENTIONS OPEN TO COMMERCIAL EXHIBITORS.

The dates given are when the commercial exhibits are open which is not necessarily the duration of the entire event.

33rd., ANNUAL TORONTO SPORTSMEN'S SHOW
Location and Dates
March 14 — 23, 1980.
Toronto, Exhibition Place
Exhibit Rates
Booth space $3.25 per sq. ft.
Bulk space $2.10 per sq. ft.
Contact
Canadian National Sportsmen's Shows
Box 168, T-D Centre,
Toronto, Ont. M5K 1H8
(416) 862-7800

3rd., ANNUAL CANADIAN ENERGY EXPOSITION
Location and Dates
March 15 — 23, 1980.
Toronto. Ontario Science Centre
Contact
Ryerson Energy Centre,
Ryerson Polytechnical Institute
50 Gould St., Toronto, Ont.
M5B 1E8 (416) 595-5071

2nd., CONFERENCE ON METEOROLOGY OF NORTHERN NEW ENGLAND AND THE MARITIMES
Location and Dates
March 21 — 22, 1980.
Fredericton, N.B.
Keddy's Motor Inn
Contact
R.B.B. Dickison,
University of N.B.,
PO Box 4400,
Fredericton, N.B.,
E3B 5A3 (506) 453-4501

WINNIPEG INTERNATIONAL BOAT SHOW
Location and Dates
April 2 — 6, 1980. Winnipeg, Man.
Convention Centre
Exhibit Rates
Booth space $300 per booth (10' x 10'), bulk space $1.40 per sq. ft.
Contact
Canadian National Sportsmen's Shows
Box 168, T-D Centre,
Toronto, Ont. M5K 1H8
(416) 862-7800

CANADIAN PUBLIC WORKS EXHIBITION
Location and Dates
May 4 — 6, 1980. Toronto.
International Centre
Exhibit Rates
$5.50 per sq. ft.
Products displayed
Equipment and methods for the largest municipality to the smallest city.
Contact
Edwin Kastner Show Productions Organization Ltd.,
33 Isabella St., Ste 102,
Toronto, Ont. M4Y 2P7
(416) 960-8739

14th., ANNUAL CMOS CONGRESS AND AGU SPRING MEETING
Location and Dates
May 22 — 24, 1980. Toronto.
Harbor Castle Hilton Hotel
Attendance
2400
Exhibit Rates
Booth space US $600 (10' x 10')
Contact
Conventions West Inc.,
9015 Wilshire Blvd,
Beverly Hills, CA 90211, USA.
(213) 278-2326

AIR INDUSTRY EXPOSITION
Location and Dates
November 25 — 27, 1980.
Toronto.
Harbour Castle Hilton Hotel
Attendance
5000
Exhibit Rates
$10 per sq. ft.
Products Displayed
Aircraft and helicopter mfrs. Engine, avionic and system mfrs. component and service companies, suppliers to the industry.
Contact
Industrial Trade Shows of Canada,
36 Butterick Rd., Toronto, Ont.
M8W 3Z8 (416) 252-7791

ISA INSTRUMENT SHOW
Location and Dates
October, 1981 & 1983. Toronto.
Skyline Hotel, Rexdale.
Exhibit Rates
Booths $250 (10' x 8')
Contact
Southex Exhibitions,
1450 Don Mills Rd,
Don Mills, Ont. M3B 2X7
(416) 445-6641