Chinook

VOL. 2 NO. 1

FALL 1979

INSIDE *WOODSTOCK TORNADO*
THE WEATHERMAN IN COURT
A CASE OF BLOCKING
DARK DAYS

FOR CHRISTMAS 1979

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COVER

The photograph, taken by the *Daily Sentinel-Review*, Woodstock, captures the tragedy at Oxford Centre, one of the six Ontario communities devastated by a tornado outbreak during the late afternoon of Tuesday August 7, 1979. Scenes such as this were common along the tracks of the two tornadoes which slashed through the area around Woodstock. It is amazing, in view of the complete destruction in many cases, that no more than two human fatalities occurred, although livestock penned in farm buildings were killed by the hundred. These tornadoes, preceded by three others (far less severe) elsewhere earlier that day, have caused concerned citizens and politicians to call for reform of the way in which disaster relief is handled in Ontario. Rather than leaving the responsibility of raising relief funds to the local communities, then matching the amount from Provincial coffers (usually $1-for-$1), the representatives of more than 600 municipalities attending the 1979 annual convention of Municipalities of Ontario recommended that the Province establish a permanent disaster fund.

ANNOUNCING A TRADE PAGE

Beginning with the next issue, ***Chinook*** is pleased to welcome **Claude Labine** of **Campbell Scientific,** 10429 87th., Avenue, Edmonton, Alta., T6E 2P4, as the trade page Editor.

His page will provide a display and discussion forum for companies in the business of providing meteorological and oceanographic products, supplies or services. This growing segment of the "met/ocean" community has been in need of a voice, but has so far been without a suitable publication. **Noël Boston** Director of Ocean Sciences for **Beak Consultants Ltd.,** points out that to some degree this lack, coupled with the fact that the field at present provides neither the high profit nor big volume business that allows large scale advertising, has been responsible for the under-utilization of consulting services and their products in Canada.

PRODUCT NEWS AND VIEWS . . .

Items in a number of categories will be covered by the page. For example, articles about new or improved products, designs or services; trade opinions, concerns or business politics; news about trade shows or conventions; business profiles of top level managers; articles about business history; news of Canadian business activities in foreign countries; and finally, research and/or development activities in the industry.

A NEW LINE OF COMMUNICATION . . .

No matter which end of the business you are in — production or distribution, service or consultation, no matter what your specialty is — radar, education, home or hobby, instruments, systems, engineering, remote sensing, modification, energy applications, ***Chinook*** extends an invitation for all to take advantage of the trade page, a new line of communication with the consumer and with each other. Send your announcements, articles, comments, concerns, reviews and news to ***Chinook*** in care of Claude Labine. We'll be glad to hear from you.

The Publisher

THE WEATHERMAN IN COURT

The sky over Sudbury was cloud free on the day in question

The trial of a Chelmsford, Ontario man, appeared to be just another routine Provincial Court traffic case. Charged with failing to stop at a stop sign in Sudbury, the accused man presented the court with photographic evidence that the sign was down on the ground and therefore he was unable to see it. The police on the other hand said that the sign was up on the day of the offence October 14th, 1976, and furthermore it was not until October 17th., that highways staff reported the sign broken. What were the actual facts of the case? Either the date concerning the broken sign was somehow in error, or else the photograph was taken at a time other than the day in question. In order to solve this dilemma, unique use of meteorological evidence brought about a conviction on the charge, as well as a plea on the part of the accused to being guilty of perverting the course of justice.

A weather satellite photograph (this page) was shown to the court by David Murdoch, an Environment Canada climatolotist, which indicated that the sky over Sudbury, indeed over the majority of Ontario, was cloud free on the day in question. Observations from the Sudbury weather station confirmed that there were only a few strands of very thin cirrus cloud present which did not obscure even a small portion of the blue sky. Obviously the photo must have been taken at some other time because it showed a dense overcast sky, with clouds of the stratocumulus variety. A check of the Sudbury weather records quickly revealed that these clouds were actually consistent with those on the day the sign was reported down.

For what is believed to be the first time in a Canadian court, a weather satellite photograph was the key piece of evidence in obtaining a conviction. The fact that this may have been a first, is an indication of how recent has been the development of forensic meteorology in this country. Increasingly however, weather information is being used by the police and pathologists as an aid in solving crimes. It is also used by litigants in civil law cases. Environment Canada climatologists all across Canada, such as David Murdoch and Tom Moyer who deal with Ontario court cases, are being called upon more frequently to present evidence. Between them these two men, for example, attended 78 court cases in 1978. The ways in which weather conditions play a role in criminal cases, contentious insurance claims, negligence and liability cases, almost defies the imagination.

Take the case of The Crown vs a Toronto woman. She was charged with operating a bawdy-house in a downtown city apartment. In order to obtain a conviction it was necessary for morality squad officers to witness the activities within. One particular evening, a policeman on surveillance duty in a nearby courtyard between the hours of 7 and 10 pm., was able to see into the apartment because, he testified, wind gusts blew aside the curtains in the open window. The defence lawyer attempted to discredit this testimony by submitting documented evidence that the night was in fact cool and overcast with rain, conditions which contradicted the policeman's story and threw into doubt his claim concerning the gusty wind and open window. Impartial evidence presented by Mr. Murdoch, and substantiated by the records from the nearby downtown weather station, showed that both men were correct in their facts. That particular evening was warm, and an approaching weather disturbance did cause gusty winds. At about 10 p.m., the disturbance moved through and was followed by much cooler air, overcast skies and rain.

Corroborating weather testimony is frequently essential in civil negligence cases such as the suit brought against a small town by the driver of an automobile. After plowing into a firetruck parked on the roadside but obscured by a pall of smoke, he claimed that the Town was responsible for the negligence of the fire fighting crew in leaving it downwind from the fire. Meteorological evidence introduced into the trial showed that at the time the firemen responded to the emergency, the wind was blowing from another direction, but shifted so as to blow the smoke across their truck while they were fighting the fire. As a consequence, it was found that they were not negligent in choosing a place to park their truck. In another case, a snowmobiler was charged with arson after he presented an insurance claim for his burned-down cottage. As he presented the facts, a chain of events led to the fire. Because his snowmobile wouldn't start, he poured gasoline down the spark-plug holes. This in turn caused it to backfire setting the machine ablaze, then the flames spread to the shed in which it was housed, and finally to his cottage which went up in smoke. However, the fire marshal and insurance investigators were somewhat perturbed by the fact that the sparks would have to had travelled 170 metres upwind for the fire to spread from the shed to the cottage. Again, weather information, specifically the wind conditions that day, were critical in obtaining the conviction.

As a final example of the simple, testimonial use of weather data in court, take the embroglio between a consumer and a painting and decorating firm. The consumer hired the firm to paint his house, specifying that the painter should use latex paint and that the job should be done early in the day. The chance of thunderstorms was forecast for the day that the painter arrived, and at noon a heavy thunderstorm washed off all the paint. The painter brought a suit against the consumer after he refused to pay the bill following allegations that the painter should not have painted on a day when thunderstorms were expected. The painter was quoted as saying that if he didn't paint on all the days when thunderstorms were forecast, then he would never get any work done. In this case it was necessary to corroborate the fact that thunderstorms had occurred, but unfortunately for the consumer, this didn't help because the judgement went against him.

A very important use of weather information has recently been developed by the investigative units of both the police and pathological services in co-operation with Environment Canada and the Defence and Civil Institute of Environmental Medicine. Inferences can be made from the course of weather events which enable detectives to determine important details which help to solve crimes. The Sudbury traffic violation is an example of this type of procedure, but not all cases are as simple. The trial and conviction of John Wildman for first degree murder will illustrate. One of the very crucial issues in this trial was to establish that his victim Tricia Paquette, a little eight year old girl, had been killed on the morning of Wednesday, February 15, 1978, as Mr. Wildman had established an alibi for all other times during the period of February 16 to February 19, 1978. This fact could only be established by knowing the time of death, a formidable task since her clothed and frozed body was found on top of loose snow cover (see photo this page). She had been missing for four days and death had occurred by bludgeoning at the site where the body was recovered. In order to determine the time of death, it was necessary to model the body cooling as accurately as possible and then work backwards from the known facts at the time the body was discovered.

Dr. Lorne A. Kuehn of the Defence and Civil Institute of Environmental Medicine, an expert on hypothermia, performed experiments with two dogs, each approximately of the same body weight as the victim. By using insulation similar to the protection afforded by the girls clothes, and exposing the bodies of the dogs to a simulation of the actual environmental conditions created in a climatic chamber, he was able to refine the simplistic Newton's Law of Cooling[1] usually used to calculate the rate of heat loss. The success of the cooling experiment depended, among other things, upon an accurate and detailed knowledge of the environmental temperature changes. With this information, supplied by Mr. Murdoch, Dr. Kuehn calculated that freezing of the entire body was accomplished in approximately forty-six hours. This placed the probable time of death at about two hours after the little girl was abducted — a time for which Wildman could not give a satisfactory account.

In the opinion of Keith Swanson, Assistant Crown Attorney in Brantford where the trial was conducted, Dr. Kuehn's calculations would have been speculative without the precise meteorological data, and would not have been admitted by the trial judge. To use the Attorney's words, "in all likelihood, a murderer would have walked free."

Acknowledgements

Thanks are due to David Murdoch, AES Scientific Services, Ontario Region, for the provision of the material for this article. Also to the Brantford Police Department for permission to use the photograph of Tricia Paquette. Details concerning the body cooling in the Wildman trial were obtained from **Body Cooling after Death** by L.A. Kuehn et al, Defence and Civil Institute of Environmental Medicine, Downsview, Ontario.

[1]Newton's Law of Cooling, $dT/dt = -k\,(T-T_a)$, says that the rate of temperature change of a thermally homogeneous object is proportional to the difference between its temperature and that of the ambient environment.

THE WEATHER AMATEUR

PHOTO 1

SIMULATED ACID RAIN EXPERIMENTS

by Couban and Hubbard

PHOTO 3

At the 18th., Canada-Wide Science Fair, **Stella Couban** and **Amanda Hubbard** (both grade 12 students at Sir John A. Macdonald High School, Five Islands Lake, Nova Scotia) exhibited a study concerning the effects of acidic rain on plants. In their opinion, the results of the study imply that acidic rain may be detrimental to the farming and forest industries as well as to private gardens (see ***Chinook***, Summer 1979 for more about this topic). Specifically, their aim was to observe the effects of H_2SO_4, principally in the form of simulated acidic rain, on Little Marvel peas and grass plants grown in controlled environments. They describe their project as follows:

1. "For the first experiment it was desired to simulate the H_2SO_4 found in the ground as a result of seepage or absorption after rain. Twelve pea plants in individual pots were grown in 5 groups. Three different strengths of acid were applied directly to the soil in which they were planted; 1.83×10^{-1}M to 3 plants; 1.83×10^{-3}M to another 3 plants; 1.83×10^{-5}M to yet another 3 plants as well as a control application of distilled water to the remaining 3. The first group were given their acid treatment at seed planting, the second at 24 hours after planting, the third at 3 days, the fourth at 5 days and the fifth at 7 days.

2. "The same experiment was repeated, but this time acid of varying strengths was sprayed onto the plants with an atomizer to simulate acidic rain. In all cases the growing medium was kept constant.

3. "Another experiment was performed where the spray was applied to grass seeds in an attempt to study the effects on a type of plant which is not only very different from the pea, but which is also almost universally found. Various problems were encountered in obtaining consistent results as the grass showed much greater natural variability, both in height and time of germination, even when grown under identical conditions.

"In experiment 1, when the acid dilutions were applied directly to the soil, it was found that the very strong 1.83×10^{-1}M solution prevented germination and growth completely when applied at planting and 24 hours, while inhibiting growth considerably when applied at 3, 7 and 8 days (photo 1). The weaker 1.83×10^{-5}M solution increased growth as compared to the control, while the intermediate 1.83×10^{-3}M solution had inconsistent results.

"When the same dilutions were sprayed

PHOTO 1. THE EFFECT OF APPLYING STRONG ACID dilution at various time intervals directly to the soil in which peas were planted seriously hampered germinations, although it must be noted that the dilution of 1×10^{-2}M is much stronger than the actual strength of acidic rain.

PHOTO 2. A GROUPING OF HEALTHY CONTROL PLANTS which were treated at the same time intervals but with distilled water, and which were grown in identical soil.

PHOTO 3. STELLA COUBAN (left) AND AMANDA HUBBARD pose with their display at the 18th. Canada-Wide Science Fair.

FIG 1. PLANT HEIGHT VS. TIME after a daily application of distilled water or simulated acid rain of different strengths for 7 weeks. The average height (in cm) of the 3 plants receiving these treatments was graphed each day. There is some stunting after 40 days.

FIG 2. NODES VS. TIME under the same experimental conditions. For each set of 3 plants, a daily average of nodes (leaves growing from a common point) was plotted. Considerable divergence from the control plants can be seen.

PHOTO 2

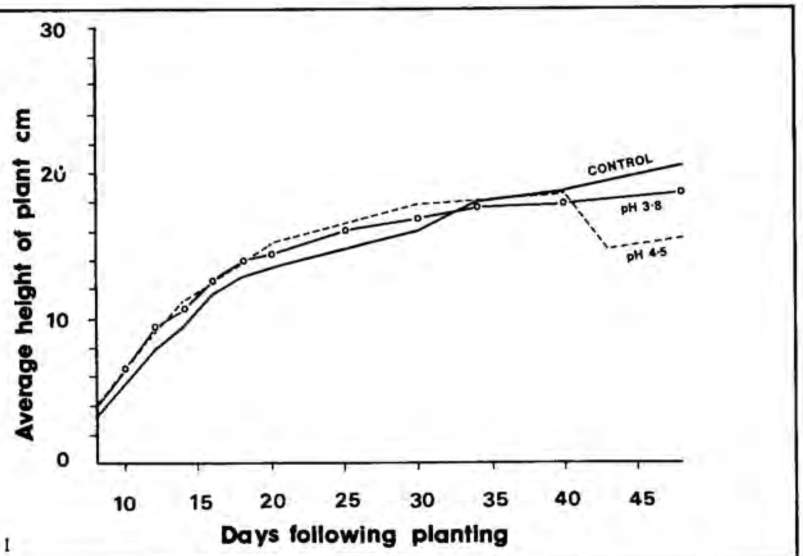


FIGURE 1

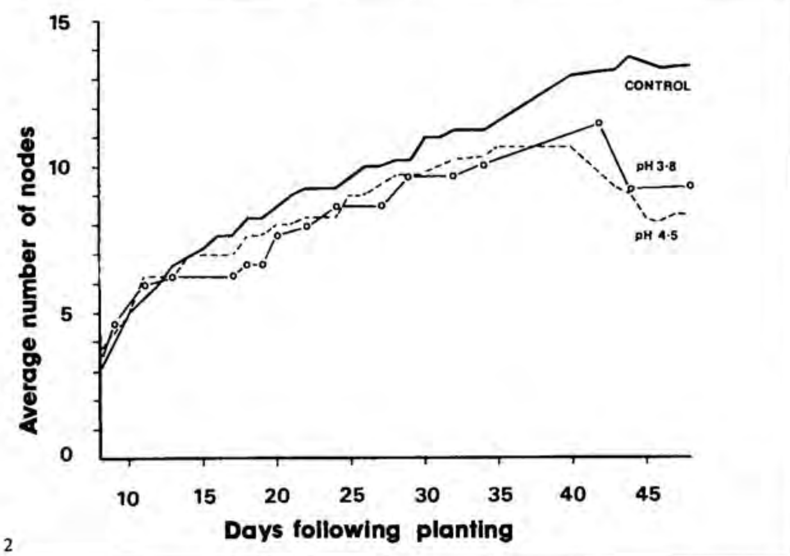


FIGURE 2

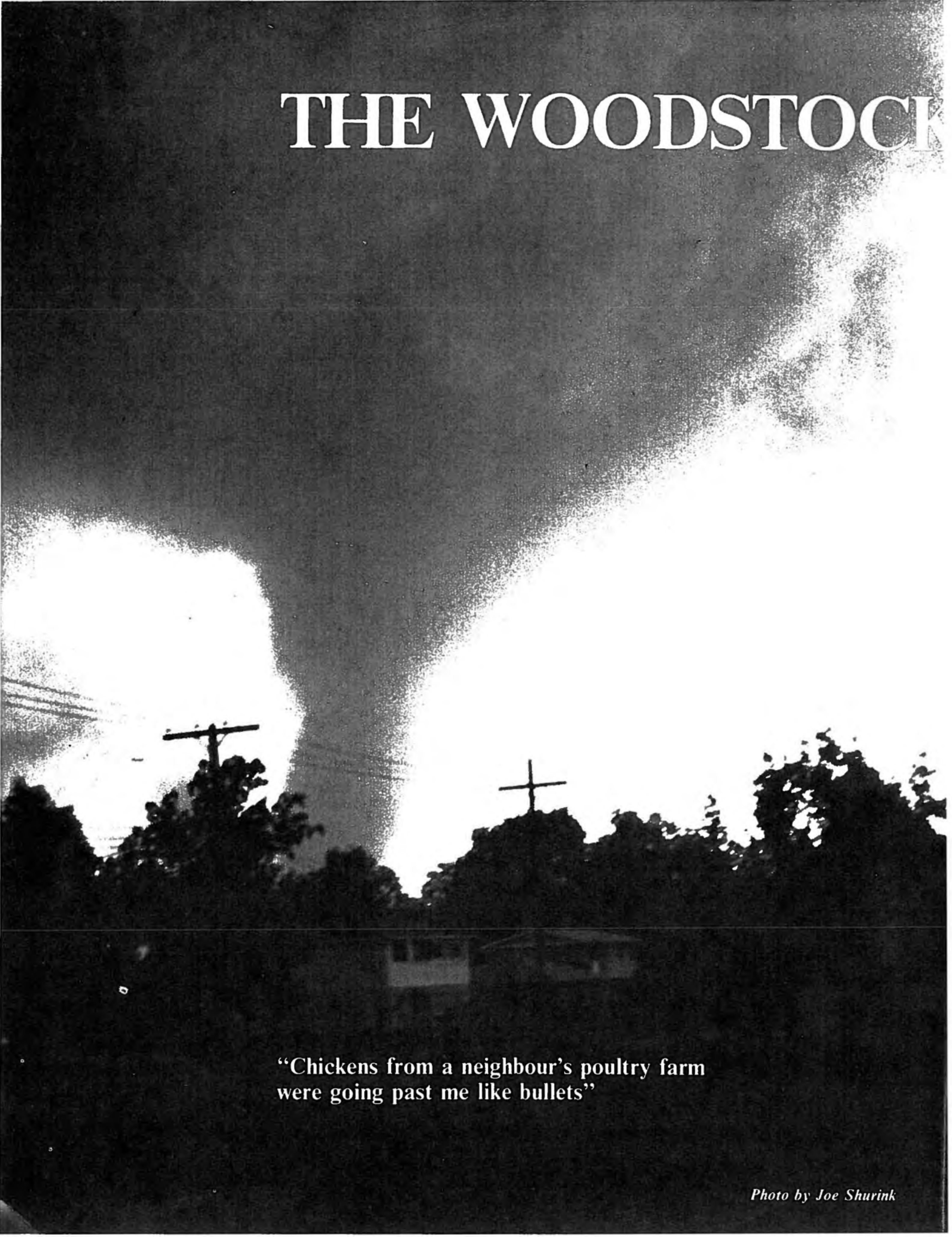
onto the plants in experiment 2, it was found that growth was most drastically affected when applied at 3, 5 and 7 days after planting, with little or no affect when applied at planting and 24 hours. Comparing the results of these two experiments shows that the means of application determines the stage at which plants are most vulnerable to the acidic rain. Apparently, concentrations of ground water after strongly acidic rain would be likely to have adverse affects on seed germination, while newly grown foliage would be vulnerable to the airborne acidic rainfall.

4. "In our next experiment we varied the medium while keeping all other variables constant. Sand, soil, vermiculite and mixtures of all three were used. The most significant results obtained were from the sand, and from the vermiculite mediums. Plants grown in the very absorbant vermiculite were affected by the acid in their early stages of growth. On the other hand, the applied acid drained to the bottom of the pots containing sand, and no ill-effects on the pea plants were noticed until later stages of growth when the roots were developed well enough to reach this accumulated source of moisture.

5. "Perhaps the most revealing and significant test we conducted was the "Cumulative Effects" experiment. The actual acid concentrations recently found in Nova Scotia rainfall (8.5×10^{-5}M to 1.83×10^{-5}M, or pH values between 3.8 and 4.5) were used and applied daily for over 7 weeks. Interestingly enough, the heights of the plants were not affected at all in the first 6 weeks of experimentation and it was only in the 7th., week that slight stunting became apparent (Fig. 1). However, the effects on the foliage or nodal growth was more marked. The acid-treated plants showed a definite and consistent reduction in their foliage growth (Fig. 2) which began in the early stages and accelerated in the later stages of growth."

These experimental results represent only a few of the conclusions reached by Couban and Hubbard (they also studied the effects of the acid upon plant roots for example), but show the potential harm of acidic precipitation on growing vegetation. Naturally, a laboratory experiment which singles out one particular environmental stress for study will not be truly representative of the real situation. It may also be said that the laboratory conditions of an application of simulated acidic rain every day for 7 weeks, or the application of very strong acid dilutions are also unrealistic. But as a demonstration of what acidic precipitation can do to growing plants, experiments such as these are a necessary first step in exploring the complex interactions of the natural ecosystem.

THE WOODSTOCK



"Chickens from a neighbour's poultry farm were going past me like bullets"

Photo by Joe Shurink

TORNADO

SEVERE STORM LOG

During the period from June 10, 1979 to August 31, 1979, at least seven Canadians have lost their lives as a direct result of storms. Two were struck by lightning in Ontario, while in each of Alberta, Saskatchewan and Quebec, one person died as the result of severe thunderstorm winds. Another two died during the tornadoes near Woodstock, Ontario on Tuesday August 7, 1979. Hail the size of tennis balls pounded parts of Calgary, Alberta on Sunday, July 29, 1979 and also fell south of Waterford, Ontario in conjunction with the Woodstock tornado.

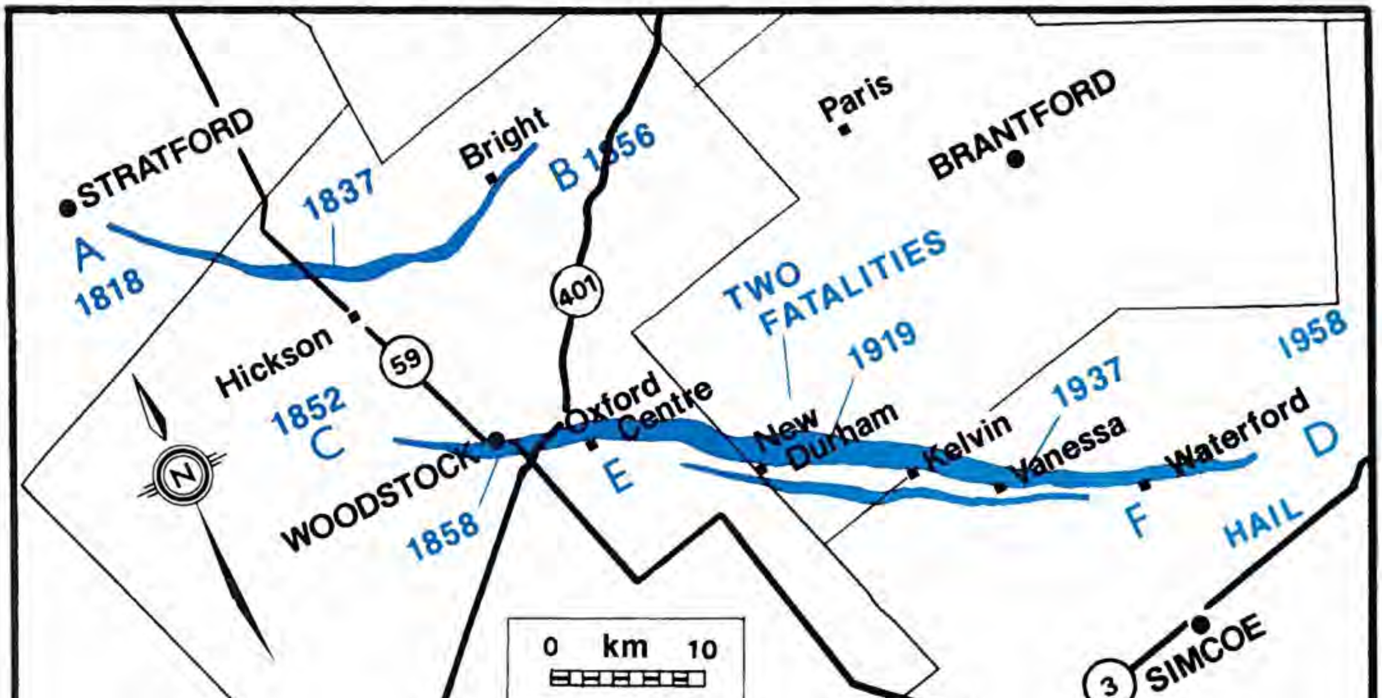
Since the tornado season began on April 5th, this year until August 31, 1979, there have been a total of 22 tornadoes across the country (possibly 29 if cases are included where confirmation is unavailable); 18 reports of funnel clouds, and 7 sightings of waterspouts. A detailed look at these events, and others for the 1979 season, will be presented in a special almanac "Severe Storm Log" column (***Chinook***, Winter 1980).

Tornadoes have been front page news in a number of communities. In Saskatchewan, where 8 have occurred, they also became a political issue after the fourth one to hit the Regina area caused $11 million in property damage on Wednesday August 8, 1979. It prompted politicians to call for the reinstatement of the Regina forecast office which had been transferred to the Prairie Weather Centre in Winnipeg earlier in the year due to federal Government budget cut-backs.

Two of the most devastating tornadoes of the year ravaged the fertile and productive area in and around Woodstock, Ontario on August 7, 1979, and were possibly the worst in southern Ontario since the Sarnia to Stratford tornado outbreak of May 1953. Words are almost powerless to describe the ruin and desolation wreaked by these storms. Incidents occurred which were so completely foreign to the orderly unfolding of daily events as to be almost unbelievable unless witnessed or experienced in person. "They were going past me like bullets" is how Gerald Dierick of Vanessa described the loss of 90% of the 50,000 chickens from a neighbouring poultry farm. Not a trace of the missing birds could be found. He had toughed out the tornado in his bucking truck while his family miraculously emerged from their home which looked as though it had been hit by a bomb. Mr. Dierick, a tobacco farmer, suffered major losses on three farms, including demolished bunkhouses and 30 brand new metal tobacco kilns which lay in a pile of junk.

Where handsome solid brick houses once stood, an inspection trip revealed only heaps of rubble. Proud trees which grace the small communities of the area were nothing but shattered and twisted trunks adorned with the debris from homes, barns and other buildings upstream along the tornado track. Cars and trucks were tossed into basements and swimming pools like childrens toys; granite tombstones weighing 200 kg or more were thrown several metres through the air. In one case, a hay mow stacked to the rafters with bales of hay and weighing all of 35,000 kg was lifted from a barn and deposited unbroken on the ground 40 or 50 metres away. Along the core of the damage tracks, almost total destruction of buildings was observed, and yet miraculously, only two people were killed although hundreds were injured or

FIG 1. THE LOCATION OF THE DAMAGE TRACKS with dimensions drawn exactly to scale 1: 506,880. Times (EDT) are indicated for the start and finish of the two tornadoes as well as for some intermediate points along the track and were obtained from weather radar and also the log of power outages maintained by Ontario Hydro. While the speed of travel of A-B was constant, C-D travelled the first two thirds of the track at 70 km/h but slowed to 45 km/h. (Track E-F was caused by a secondary funnel).



left homeless. Hundreds of cattle and pigs were killed by the collapse of barns and trees. A farmer in Oxford Centre was forced to destroy some of his cows which had been impaled by barn beams.

A sadly impressive array of statistics emerge from these events. More than 600 houses or farm buildings were damaged (over 350 houses in southwest Woodstock alone), as well as scores of industrial or commercial premises, 9 churches, 3 schools, and 28 hydro electric transmission towers. Crops of corn and tobacco along the track were flattened, orchards were uprooted and whole stands of trees looked as if they had been shelled by a World War II bombardment. A complete accounting of the damage is awaited, but estimates of the total damage caused by the two tornadoes run as high as $100 million with $20 million of that being in the form of uninsured losses.

A survey of the damage paths reveals that there were two main tracks (labelled AB, CD in figure 1) with a secondary track (labelled EF) associated with the Woodstock tornado. EF provides tangible evidence of the existence of two funnels as claimed by some eyewitnesses. The physical characteristics of damage track length, width and area, as well as the speed of the tornado cells (as determined from weather radar and the time of power outrages on the hydro lines) are shown in table 1. If the damage estimate is anywhere close, then these tornadoes caused havoc at the rate of $10,000 per minute, or looking at it another way, at a cost of $8,500 per km^2.

Photographs of the tornado which passed through Woodstock were taken by Joe Shurink and Dominic Scalisi, allowing calculations to be made of the funnel width and height. Knowing the camera lens and film geometry, and the distance of the photographer from the funnel (1.1 km in the case of the photo shown), it is calculated that the funnel tip was 120 m wide and the funnel height was about 300 m. Joe Shurink, an ambulance driver, chased the tornado by car, and saw the outer elements of the cloud rotating in a counter-clockwise direction. He was close enough to see the John Knox Christian Church on Norwich Avenue in Woodstock being demolished, and described how the bricks seemed to pop out and shoot up into the funnel like ashes.

Chinook made a study of the distribution of damage to a number of partially wrecked homes in order to determine which portion of the first floor of the buildings, on the average, provided the most safety. In-ground basements were excluded since they remained intact in all cases. Each building surveyed was divided into quarters and an estimate made of the total percentage of damage to each segment. The results, shown in figure 2, indicate that most damage (61%) was inflicted upon the approach side (northwest) of the buildings, and the least (17%) was suffered on the side opposite (southeast corner) to the approaching tornado. There were a few individual cases where exactly the reverse was true. This can be explained by the fact that the air along the tornado track frequently converged strongly to a centre line, as evidenced by the direction of tree and crop fall. Thus a building on the east side of the convergence line would sometimes be subjected to strong inflowing winds which would first impinge upon the eastern walls causing the major damage there. It was along the convergence line itself that almost complete destruction occurred. Of the 24 buildings surveyed for this case study, 9 were solid brick two-storey houses, 9 were wood frame or frame with brick veneer or aluminum siding, 1 was solid stone and 5 were commercial or institutional buildings. A little more than half of the solid brick houses examined suffered a total loss of the top floor.

Tornado Track	Width Range km	Length km	Approximate Area km^2	Average Speed of tornado km/h
A — B	0.2 to 1	33	20	50
C — D	0.5 to 2	59	80	55
E — F	0.1 to 0.9	29	17	unknown

TABLE 1. THE PHYSICAL CHARACTERISTICS OF THE DAMAGE TRACKS of the two Woodstock area tornadoes (track E-F was caused by a secondary funnel associated with the major tornado which travelled from C to D). The average speed at which the tornadoes travelled from one end of the track to the other is also shown.

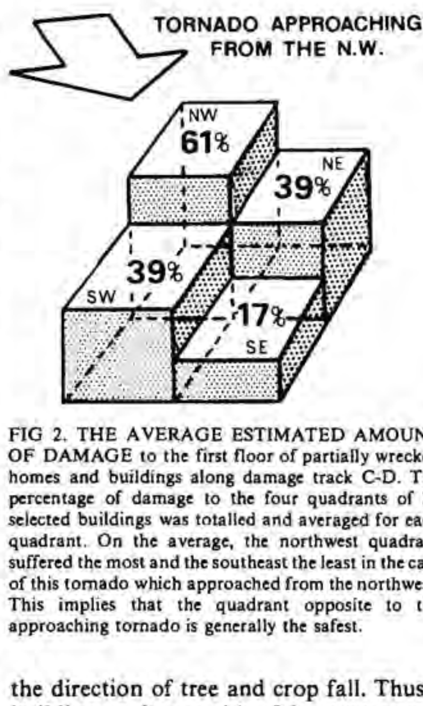


FIG 2. THE AVERAGE ESTIMATED AMOUNT OF DAMAGE to the first floor of partially wrecked homes and buildings along damage track C-D. The percentage of damage to the four quadrants of 24 selected buildings was totalled and averaged for each quadrant. On the average, the northwest quadrant suffered the most and the southeast the least in the case of this tornado which approached from the northwest. This implies that the quadrant opposite to the approaching tornado is generally the safest.

In general, the basement seems to be the best refuge and the second floor the worst. On the first floor, the safest side is apparently the one opposite from the approaching tornado. However there were a number of individual examples where this was not necessarily true. In the case of Gerald Dierick, his family survived because they were fortunate in choosing the side of the basement other than the one bombed by all the second floor debris. In another case, a car and pick - up truck were dumped into the completely exposed basement, while in the case of Bill Hampson's 119 year old two-storey solid brick house in Oxford Centre, it was the southeast side which was totally demolished.

Three weeks after the tragic events, heartening signs of restoration were in evidence. A number of barns were already gleaming silver in the sun where Mennonite Disaster Service teams had quietly but quickly gone about their business of providing skilled labour to reconstruct. Emergency centres for processing insurance claims were in full swing. The provincial Government had promised to contribute substantially more than the usual $1 for every dollar in aid raised privately, and some of the devastated forest tracts were already being transformed from a tangled nightmare into neat piles of sawn logs.

One disquieting thought remains. In 1978 it was Masson, Quebec and Aubigny, Manitoba that were in a similar plight, in 1977 it was Rosa, Manitoba and the area south of Beamsville, Ontario. In 1975 it was St. Bonadventure, Quebec and in 1974 Windsor, Ontario. In 1972 Maniwaki, Quebec; 1970 Sudbury, Ontario. Furthermore, this was not the first time that Woodstock has been severely mauled by a tornado. In June, 1856, the town and area experienced a tornado of equal magnitude which took 4 and possibly 5 lives. How long will it be before we wake up to the fact that devastating tornadoes are not freak events which have somehow wandered out of their rightful domain in the U.S., but are a relatively frequent and common occurrance in portions of Canada. As population density increases, and buildings and industry proliferate, an ever increasing incidence of tornado damage can be expected.

ISIS Photo

DARK DAYS

by Scott Somerville

"On the morning of Sunday, November 8th, 1819, the sun rose upon a cloudy sky which assumed, as the light grew upon it, a strange greenish tint, varying in places to an inky blackness." From Quebec to Kingston, in nearby states of the U.S., and particularly in Montreal, this was the beginning of the "Phenomenon of 1819". Reminiscing in the *Montreal Star*, Mr. J.H. Derwin continued; "after a short time there followed a heavy shower of rain, which appeared to be something of the nature of soap-suds, and was found to have deposited . . . a substance resembling soot." The 9th., was fine and frosty but on the morning of the 10th., the sky was again covered with deep green to pitch black clouds. The sun, when occasionally seen through them varied from dark brown to an unearthly yellow and even blood red. Mr. Derwin's story continued; "the day became as dark as night. At noon, lights had to be burned in the Court House, the banks and public offices of the city. Everybody was more or less alarmed. The more sensible thought that immense woods or prairies were on fire somewhere to the west, others said that a great volcano must have broken out in the Province, still others asserted that our mountain (Mont-Royal) was an extinct crater about to resume operations and to make of the city a second Pompeii. The superstitious quoted an old Indian prophecy that one day the Island of Montreal was to be destroyed by an earthquake. Some even cried that the world was about to come to an end."

During the middle of the afternoon a thunderstorm flared through the darkness and again a shower of sooty or soapy rain fell. Lightning was observed striking the spire of the old French Parish Church, playing curiously about the large iron cross at its summit. A moment later, in Mr. Derwin's words, came the climax of the day. "Every bell in the city suddenly rang out the alarm of fire and the affrighted citizens rushed out of their houses into the streets and made their way in the gloom towards the church. The Place d'Armes was crowded with people, their nerves all unstrung by the awful events of the day, gazing at but scarcely daring to approach the strange sight before them. The sky above and around was as black as ink, but right in one spot in mid-air above them was the summit of the spire with the lightning playing about it, shining like the sun. Directly the great iron cross, together with the ball at its foot, fell to the ground with a crash and was shivered to pieces."

After this momentous event the glow gradually subsided, the people grew less fearful and returned home. The next morning dawned bright and clear and the world was as natural as before. Today, one hundred and sixty years after this incident, an explanation is actually rather simple. The alarmed residents of Montreal had just witnessed what is commonly referred to as a "Dark Day". Sometimes they can be caused by intense volcanic eruptions which spew vast quantities of particles into the atmosphere, but in this case the "sensible people" of the day were very likely correct to conjecture that immense forest or prairie fires burned somewhere to the west.

Approximately sixty years after that memorable Montreal Dark Day, another of these eerie incidents occurred in southern Ontario. On the Monday afternoon of September 5, 1881, the sky turned a greenish hue and darkened until it was necessary to light the lamps in all the stores and houses. Although groups of people gathered outside shops in London to deliberate the matter, newspaper reports indicate that the alarm which characterized the 1819 event was not as prevalent on this occasion. Some fanatics declared persistently that the world was ending, others were certain it was due to an approaching comet, but the majority reasoned that forest fires in Michigan were primarily responsible.

Their opinion was verified when a steady shower of fine cinders and ash drifted down from the sky. Witnesses reported that by 4 o'clock in the afternoon "it was as dark as midnight, it being quite impossible to see a yard ahead." The air was so choked with smoke that "one was almost stiffled on going out into it." By the next day though, the sun shone as if nothing had ever happened.

Dr. Joseph Workman's diary discussed the smoky skies over Toronto. He briefly detailed the events leading to the situation. "August has been hot and dry and the country is in great want of rain" he wrote on August 31st., 1881. "Brush fires prevail in many places, and tonight the city is full of smoke." From August 31st., to September 10th., Dr. Workman presented almost daily references to the smoky skies over Toronto. There were numerous newspaper reports concerning the event, some of which gossiped about great wind storms that fanned the flames, burning homes and forests.

As recently as 1950 an overwhelming daytime darkness swept over London, Ontario on September 24th., giving the distinct impression that an immense storm was brewing. Before radio stations began broadcasting explanations, guesses concerning the cause ranged from a surprise eclipse to a Russian smoke screen. This Dark Day simply evoked curiousity rather than the terrified response of the residents of Old Montreal.

The smoke over London originated in far-away northwestern Alberta and northeastern B.C. where three weeks of drought and warm weather sparked over one hundred forest fires. Airline pilots in the east reported that the smoke was to be found mainly in the layer from 2.5 km to about 4.5 km above the earth. By 1 or 2 pm on the 24th., it was so dark that artificial lighting was required although at times an eerie yellowish light prevailed in the sky. There was no smoke at ground level in this area, and the horizontal visibility was actually unlimited. Southwestern Ontario was not alone in the dark as the smoke pall spread over much of central and eastern Canada, the eastern U.S. and ultimately, even western Europe. European press reports told stories of a bluish sun and moon as well as the smoky nature of the sky. Although forest fires are a common event, it is only once in a blue moon that their smoke attains the intensity to create a Dark Day.

FURTHER READING

Wexler, H. 1950: **The Great Smoke Pall — September 24-30, 1950** *Weatherwise* Vol. 3, no. 6, pp 129-134, 142.

A CASE OF BLOCKING

Photos Courtesy OMNR

The 1979 spring and summer season was long, hot and dry in western Canada. By late June the spectre of drought threatened southern Alberta. In July, concern arose about the water supply there, while in northeastern sections of the province, as well as in neighbouring areas of Saskatchewan and the N.W.T., forest fire smoke filled the air reducing the visibility to a few kilometres. The dry cloud free days persisted, setting record hot temperatures in interior British Columbia as early as May. During an intense heat wave in July, record high readings of 40°C were observed at Kamloops, Penticton and Kelowna. By the end of August it was apparent that this was the worst forest fire season in Alberta since 1968. The estimated cost of fighting more than 800 fires rose to $8 million. In the forest districts of Athabasca, Whitecourt, Slave Lake and Edson more than 1620 km^2 were burned, an area one-third the size of Lake Manitoba. Yet during this same period that parched the west, the Maritimes suffered through a number of very heavy rainfalls.

Why? What causes these periods of drought with their attendant forest fires and agricultural problems, while at the same time other parts of the country experience copious rains? *How* this situation arises can be explained by examining the largest scale of air motion in the atmosphere. These are winds which flow smoothly at altitudes above the air disturbed by friction near the earth's surface. Streaming in a meridional (north to south to north) wave pattern around the hemisphere, these winds drive the excess equatorial heat and moisture from southern to more northerly latitudes, and on their return trip from the north they tend to force cool polar air towards lower latitudes. This airflow sets up standing waves in each hemisphere at mid-latitudes, varying in number from 3 to 6 depending upon season, and with wave-lengths from 3000 to 6000 km. The normal motion of an individual wave (as distinct from the air flowing through it) is a very slow drift from west to east. Occasionally they will show discontinuous motion, appearing to jump towards the west as a new wave is created. Quite often they will become almost stationary over one particular geographical region, and if this behaviour is prolonged, then the fine dry weather associated with the ridge portion of the wave system turns into a drought, while frequent rains accompany the trough portion of the system.

Why the atmosphere exhibits this type of "blocking" behaviour is a puzzle which has been vexing meteorological researchers ever since the waves were first described by C.G. Rossby in 1939, and has been the subject of much investigation. Recently, J.L. Knox of the University of British Columbia, presented a report which assessed the frequency of such blocks in the atmosphere over the northern hemisphere during the period 1947-1963. Over Canada, he found that on the average, the maximum incidence of blocked ridges in winter was centered in the Baffin Island — Davis Strait area (60°W). In spring, this maximum retreated westward and southwards to Hudson Bay (85°W). By summer the maximum had retreated still further west and north to the vicinity of the Magnetic Pole (100°W). Finally by fall, the maximum blocking incidence had moved back eastward to near 80°W. These seasonal changes result in several well known climate patterns such as the extended period of fine warm fall days in eastern Canada known as "Indian Summer", or the very cool, cloudy weather which persists across portions of Ontario and Quebec in spring when the air flows continually off Hudson Bay.

In view of these findings, it should not come as a surprise that a blocked ridge developed over western Canada this past spring and summer, with a downstream trough just west of the Maritimes. A convenient method of condensing these wave systems of ridges and troughs into a neat diagram was originated in 1949 by Ernest Hovmôller of the Swedish Meteorological and Hydrological Institute. A Hovmôller diagram for the period from April 1979 to August 1979 is shown on page 13. For the sake of simplicity, only the ridges are shown (although between each ridge there is a trough) and their changing longitude with time is displayed by the dashed lines. The longitude zone of Saskatchewan, Alberta, B.C., and the Yukon (100°W to 120°W) is marked by the vertical bar. The number of waves around the hemisphere during this period varied from 4 to 5, and periods occur when the waves were obviously moving from west to east (for example, the period from May 7 to June 18 when the slope of the dashed lines can be most clearly seen). The remarkable feature, however, was the very strong tendency for a persistent nearly stationary ridge (between A and B in the diagram) at the longitude of western Canada. Even during the periods of migration, the ridges tended to settle into this longitude for a while.

In the years before daily sampling of the atmosphere's high level characteristics began, persistent blocks can be inferred from known periods of drought. The results of these periods were sometimes catastrophic, not only in terms of agricultural failures (the dry 1930's for example) but also in terms of disastrous forest fires. Some of these were maelstroms of fire which generated their own hurricane force winds and were capped with thunderheads formed from the moisture released by the burning vegetation. Raging for weeks in forest environments so dry that the very forest soil was consumed by the flames (photo p. 12), temperatures along the fire front reached an estimated five or six hundred degrees Celsius, and were hot enough to buckle and twist steel railroad lines and turn them cherry red. Driven by the whims of the atmospheric wind and leaping ahead as firebrands and exploding combustibles set advance flames, firestorms such as these sometimes overtook and incinerated whole villages and towns before the inhabitants were fully aware of the true extend of the fire.

One of the earliest of these tragedies was the Miramichi Fire in New Brunswick during early October 1825. The smoke from more than 11,000 km² of burning forest extended throughout the Maritimes,

Cont'd p. 14

A strong and persistent ridge produced record warm temperatures in B.C. and the Yukon. To this date there had been little or no rain for two weeks.

The ridge moves eastwards and a trough moves in from the Pacific. As a result 60 mm of rain fell on the west coast and 15 to 30 cm of snow fell in southern Alberta.

A forest fire at Rolling Dam, near St. Stephen, N.B. destroyed 10 homes, a covered bridge, and burned more than 400 hectares of forest, Up to this time there were 57 spring forest fires in N.B.

Some record warm temperatures in interior B.C.

Northern Alberta was wetter than normal as the ridge broke down.

Trough produced very little rain.

First signs of drought in southern Alberta. Critical forest fire burning conditions developed in the forest districts of Whitecourt, Slave Lake, Edson and neighbouring areas of the N.W.T.

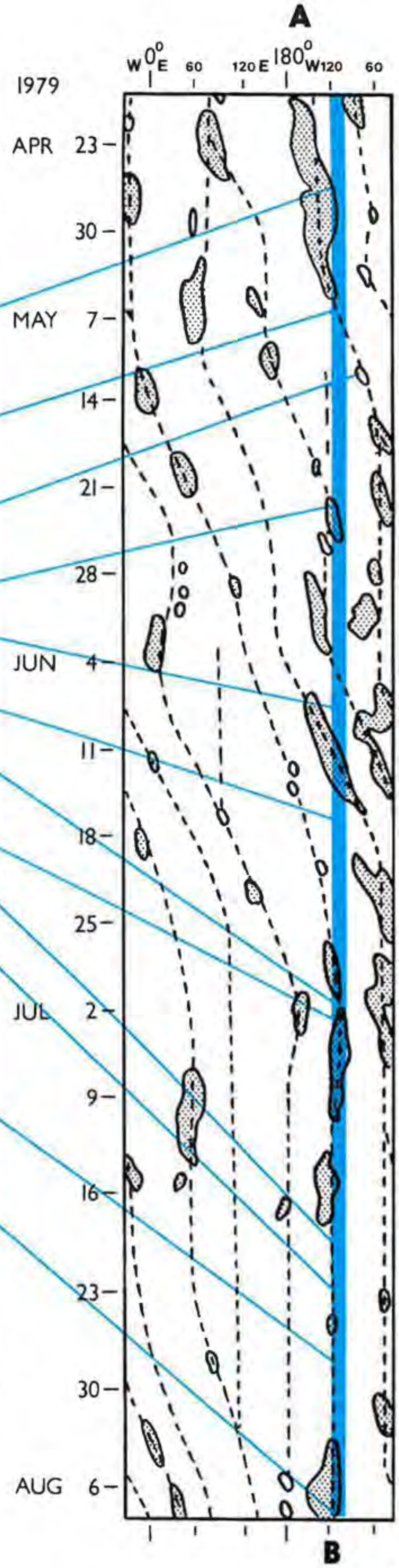
The period from May to July 3rd., was the driest on record in southern interior B.C.

A heat wave in B.C. and the prairie provinces. Continuing persistently dry. Concern about the water supply in southern Alberta.

Up to this date there had been 629 forest fires in northern Alberta burning 134,000 hectares.

Rainfall only 24% of normal since June 1st., at Kamloops, B.C. An outbreak of small forest fires in the Kamloops Forest District. Persistent drought in southern Alberta caused the water supply to be turned off in the Lethbridge area due to low levels. Numerous forest fires continued in the Athabasca region of Alberta and nearby Saskatchewan.

Water restrictions in Castlegar, B.C. The total number of forest fires to this date in Alberta was 717, with 170,000 hectares burned. The worst fire season in 25 years had so far cost $5 million. in fire fighting costs.



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Cont'd from P. 13

One hundred and sixty souls from the thriving towns of Newcastle and Douglastown and the surrounding area were either burned to death or else drowned in their efforts to escape. With winter close at hand, the loss of buildings, stock and the fall harvest was particularly severe. It was noted that the summer of the year 1825, through to September, was remarkably warm, and that an unusually small amount of rain had fallen.

Almost one hundred years later, on October 3rd., and 4th., 1922, a similar tragedy befell the little villages of Charlton, Englehart, Heaslip, Boston Creek, Mindoka, Thornloe and Earlton in northern Ontario. The horrific forest fire, four townships wide next bore down upon the unsuspecting and bustling community of Haileybury. In three hours, the town was devastated (photo p. 12). People were burned to death in the streets as they ran towards the safety of Lake Temiskaming, or perished in their homes. Street car tracks writhed in the heat. Before the fire was finally brought to a halt with dynamite and hastily cut forest swaths on the outskirts of Cobalt, at least 43 people had died, with 11,000 left homeless. Again it was drought which had set the stage.

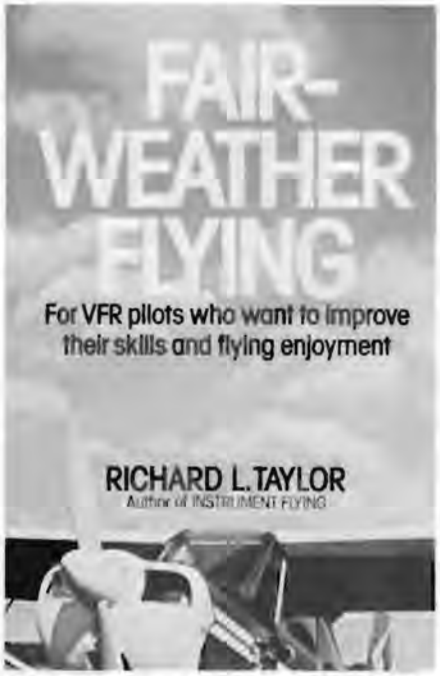
The people of western Canada suffered a similar disaster in the Kootenay, B.C., Fire of early August, 1908. Of the towns of Fernie and Mitchell, almost nothing was left save tottering walls and smoking ruins. Accounts of the number of people killed vary, but it seems that about 22 lost their lives and 7,000 were left destitute and homeless.

With modern methods of fire ranging, prevention and suppression, such calamities are no longer a threat, although in bad forest fire years, huge fires can and do rage uncontrolled for weeks at a time. Obviously, knowledge concerning the behaviour of the large scale atmospheric waves will not help prevent such fires from starting. However, by keeping track of the waves, clues can be found concerning the location and duration of the drought conditions which encourage the worst fires. This in turn is the information that Fire Control Managers need in order to make useful economic decisions about the logistics of fire fighting personnel and equipment.

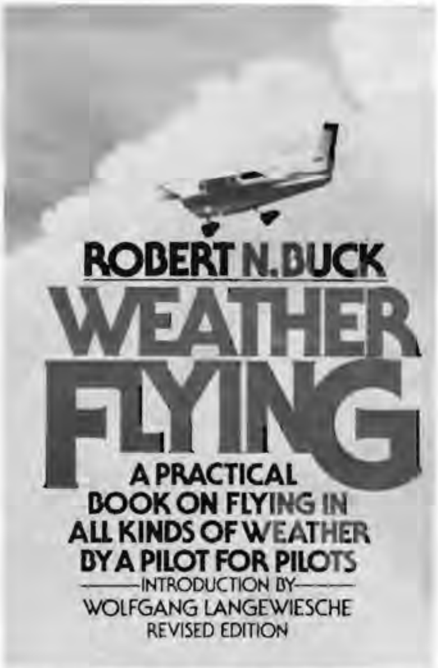
Further Reading

Knox, J.L., 1979: **Blocking Frequency in the Northern Hemisphere.** The University of British Columbia, Vancouver. Paper presented to the 13th., Annual Congress, CMOS, 1979, in Victoria.

Newark, M.J., 1975: **The Relationship between Forest Fire Occurrence and 500 mb Longwave Ridging.** *Atmosphere,* vol. 13, no. 1, pp. 26-33.



Fair Weather Flying by Richard L. Taylor. Macmillan Publishing Co. Inc., New York, fourth printing 1977. 297 pages. Hardcover $11.95



Weather Flying by Robert N. Buck. Macmillan Publishing Co. Inc., New York, second printing 1978. 296 pages. Hardcover $14.75

Once the covers of these two books with almost identical titles are opened, all similarity ceases. The reader wishing to increase the skills required for *flying* in VFR (fair weather) conditions will turn to Richard L. Taylor's book, while the reader seeking increased understanding about the *weather* and how to handle it will want Captain Robert N. Buck's **Weather Flying.**

Capt. Buck's book is the essence of 40 years of flying experience, in every kind of airplane, all around the world, in all types of weather. On one occasion he narrowly missed flying a DC3 into a tornado funnel at night. For a number of years he flew special research missions into the kind of weather that others avoid — such things as snow static, icing and thunderstorms. When he wanted to study runway visibility in fog as it appears to a pilot breaking out of a low overcast, he let himself be hoisted up into the overcast while hanging in a parachute harness from a captive balloon. A few more of these personal stories could have been used to break up the heavier theoretical lumps, and it is not until page 53 that we encounter the first of the all too few entertaining anecdotes.

Actually, **Weather Flying** is a masterpiece of simplification. Complex meteorological principles are made to look easy, and without fail are presented in a context useful to pilots with little weather knowledge. For example, the temperature and density relationship to airplane performance is very clearly explained. There are one or two slips however, Gaffes such as "snow generally forms directly from water vapour without any cloud process" come as rather a surprise, although Capt. Buck redeems himself later when it becomes evident that he is really talking about ice crystals. Canadian readers will also have to ignore his recommendation to climb above the clouds in certain circumstances in order to fly "VFR on top", since this is an illegal procedure in Canada.

For pilots who are intimidated by the weather and its complexities, **Weather Flying** is recommended reading.

With regard to **Fair-Weather Flying,** reviewer ***Carol Klaponski*** writes "the basic theme is — recognize your own limitations as a pilot and those of your airplane and then discover what both you and your machine can really do given the chance.

"Devoted as it is to another purpose, this book still finds space for two weather chapters. One, entitled "How to Chicken Out in Front of Your Friends When the Weather is Lousy", stresses that the decision to fly in any given weather condition rest solely with the pilot-in-command. The other chapter concentrates on various types of turbulence that the average pilot may encounter in flight, giving useful tips on how to avoid it wherever possible, and if caught in it how best to handle the airplane.

"Although Taylor provides a complete glossary of terms, those uninitiated into the world of flying may find **Fair-Weather Flying** of limited interest. But the pilot willing to read with an open mind will find interesting, sometimes controversial and unorthodox approaches to many aspects of flying presented in an amusing and most readable manner."

ARCH PUZZLE

by R. G. Stark

6. MEN OF COLOUR

A group of weathermen were having a meeting, Messrs. Black, Blue, Brown, Green and Grey. Strangely enough each wore a tie of a colour corresponding to the name of one of the others, and a suit of a colour corresponding to the name of another one. The man with the brown tie wore a suit corresponding to the name of the man who wore a brown suit. Mr. Grey wore a green tie and a black suit. Mr. Blue and Mr. Brown both wore some grey. Mr. Green was the only one whose tie and suit were of colors both beginning with "b". Mr. Brown never wore black. What did Mr. Black wear?

7. PLACES CONTAINING PROVINCES

Saskatoon contains SASK, the abbreviation of its province, Saskatchewan. Similar examples can be found in several other provinces. How many can you locate?

Answers next issue.

ANSWER TO NUMBER 5
(Summer 1979).

Diane Newell Macdougall, in *The Beaver* magazine, recounted stories drawn from the folklore of the Klondike gold rush concerning the "sourdough" thermometer. Kitchen items were obtained by the sourdough prospectors such as coal oil, ginger flavouring extract, as well as remedies (Perry Davis Painkiller) and liniments such as St. Jacob's Oil. Each had a different freezing point and a quantity placed in a pill bottle would indicate the temperature as it froze in turn. St. Jacob's Oil in particular was composed mainly of a mixture of water, ether, alcohol and turpentine. Ether has an extremely low freezing point which accounted for the St. Jacob's Oil remaining liquid in even the coldest weather.

IN THE NEXT ISSUE OF *CHINOOK*

The Weather Amateur column will feature an experiment by Canada-Wide Science Fair winner, Donald Netolitzky, on how to capture, study and preserve snow crystals.

The Edmonton "Chinook", by Professor K.D. Hage. Dramatic photographs illustrate this remarkable phenomenon.

"An Eye-Witness Account of a Severe Thunderstorm in 592 B.C.," by A.F. Davies.

ALSO

The Severe Storm Log will deal with the hurricanes, tornadoes and outstanding hail storms of 1979.

An examination of fluctuations in our winter climate.

AND

Chinook's new trade page.

DON'T MISS IT

Photo by
D. Netolitzky