Chinook

VOL. 1 NO. 3
SPRING 1979

INSIDE

BEEKEEPING AND THE WEATHER

H. G. VENNOR WEATHER PROPHET

BROCKVILLE LIGHTNING DISASTER

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

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

Chinook Spring 1979 Volume 1 Number 3

Articles

Departments

Editor Michael J. Newark
Publisher Weather Enterprises, PO Box 427, Brampton, Ontario, L6V 2L4

ISSN 0705-4572

Printed and produced in Canada and published quarterly by Weather Enterprises. Registered in Ottawa as second class mail, registration number 4508. Subscription rates in Canada and U.S.A. for one year $6.00, for two years $11.00, and for three years $16.00. All other countries the rates are $7.50, $14.00, and $20.50 respectively.

THE COVER

Storm over the Prairies.

Mixed media on plywood by *Paterson Ewen.*
Collection Canada Council Art Bank: Banque d'oeuvres d'art Conseil des Art du Canada.

Paterson Ewen is a painter who lives in London, Ontario and who teaches painting and drawing at the University of Western Ontario. He is a member of the Royal Canadian Academy and is represented by the Carmen Lamanna Gallery in Toronto.

"I call my works 'Phenomascapes' because they are images of what is happening around us as individuals, rain, lightning, hail, wind. They are also images of what is happening in and around our Universe, Galaxies, Solar Eruptions. They are sometimes inner phenomena. I observe, contemplate and then attack."
Paterson Ewen.

WHIRLWIND MASK SPLITS THE WINDS

I thought you might find it of interest to know about one of our items which has strong associations with your meteorological profession. The photo (above) shows our Whirlwind mask. Although carved to wear, as are all our ceremonial masks, the Whirlwind mask was never actually worn. His function was to protect the reserve from whirlwinds. At the approach of wind storms, individuals would burn Indian tobacco in a small fire outdoors and hang this face up towards the wind. His function was to split the winds to the east (the red side of the mask or the left side in the photo), and to the west (black side of mask).

Today, he is no longer in use around the reserve, and any False Face is used. Another interesting feature about him is that he does not have horse hair trim as do most Iroquois masks. He is unique to the Six Nations reserve and not found on any of the other twelve Iroquois reserves in Canada and the U.S. This is probably due to the close association of the Cayuga with the Delaware. The Delaware do not share any other reserve with the Iroquois and it is to be noted that formerly the Delaware also had a half red and half black mask. We think that he may have been adopted by the Cayuga who were always closely tied to the Delaware here and participated in other exchanges of cultural items from them.
Wm. Guy Spittal
President, Iroqrafts Ltd.,
RR 2, Ohsweken, Ontario

Continued p. 42

BEEKEEPING AND THE WEATHER

by R.W. Shuel

Weather and climate have a major part in the success or failure of beekeeping. Successful beekeeping involves the exploitation of an instinct possessed by a few species of bees — of which our honeybee, *Apis mellifera* L. is the most important — to make and store honey in excess of their immediate needs. Factors of weather and climate largely determine the availability of the nectar which the bees change into honey, the distribution of the plants which produce it, and its collection by the bees.

Honeybees are completely dependent on plants for their food needs. Sugars obtained from nectar, and proteins, vitamins and minerals obtained from pollen, are essential for their growth and maintenance. Although pollen is generally more readily available than nectar, it is an abundance of nectar plants which is the basic requirement for beekeeping.

The major climatic factors determining the characteristic vegetation of a region are amount and distribution of precipitation, and temperature with respect both to extremes and the length of the frost-free period. The greatest variety of flowering plants is found in warm climates with abundant rainfall while our Canadian climate limits the number of major honey plants, most notably in the case of tree species. Extending up from the United States into the southern parts of Saskatchewan and Alberta is a dry region where grasses form the climax vegetation. The native flora there will not support beekeeping on a substantial scale. Temperature and soil factors have also restricted the distribution of nectar trees with respect to latitude. Basswood grows up to about the 46th parallel of latitude in Ontario, Quebec, and New Brunswick[1]. Our northern forest trees, because of climatic and soil factors, are mostly coniferous — pine, spruce, hemlock, and so forth — and do not produce nectar, though bees can obtain pollen from them.

In most of Canada, with the notable exception of British Columbia, agricultural crop plants are generally more significant to beekeeping than are native species. The distribution of cultivated plants, like that of wild plants, is influenced by climate, but less directly in that the farmer intervenes, by planting crops suited to his particular climatic and weather conditions. Irrigation of dry lands in southern Alberta, for instance, permits alfalfa to be grown for seed, and the alfalfa, an excellent nectar source, supports beekeeping. The central regions of Alberta and Saskatchewan

(latitude circa 51-55°N) support the best honey production — based on crops such as alfalfa, sweet clover, alsike, red clover, and rape — of any part of Canada; yields of 110 kg per colony are not uncommon. In southern Ontario, formerly pre-eminent in honey production, nectar-secreting legumes have largely been displaced by corn, a more profitable crop for the farmer.

Low temperatures have restricted large-scale tree fruit production in Canada to such localities as the Annapolis Valley in Nova Scotia, a belt along Lake Erie and Lake Ontario in southern Ontario, and the Okanagan Valley in British Columbia. On the whole, fruit crops are minor rather than major nectar sources.

The behaviour of honeybees is affected by several weather factors of which temperature is undoubtedly the most significant. Bees respond to temperature changes in a complex way. A single honeybee by itself, for example, is incapable of surviving a temperature minus 5°C for more than a few minutes, yet a colony comprising thousands of bees can survive much colder temperatures through the winter provided they have food, and shelter in a hive or a hollow tree. The secret of their survival is a remarkable system of climate modification in which they form a cluster for generating and conserving heat. Bees in the interior of the cluster produce metabolic heat through constant movement, while those in the outer 2-8 cm shell form a compact insulating layer. The cluster acts as its own thermostat, responding to changes in the temperature outside the hive, and maintaining the outer part of the cluster at about 7°C. When the outside temperature drops below this point the cluster contracts, reducing the surface area from which heat is lost by radiation; as the outside temperature rises above 7°C, the cluster expands. The effectiveness of the heating depends on an adequate supply of fuel in the form of honey or sugar. As one would expect, strong colonies with large numbers of bees are better able to cope with winter temperatures than weak colonies. Beekeepers reinforce the system by ensuring that their colonies are strong in the autumn and have sufficient reserves of honey and pollen. Placing hives in sheltered sites and wrapping them with insulating material also helps. Even with good management, colonies may suffer heavy losses in exceptionally cold and long winters. In the Prairie Provinces many beekeepers operate their colonies on an annual basis, destroying them in the fall and building up new ones in the following spring with stocks imported from the Southern United States.

Bees also react positively to excessively high temperatures in the summer. When outside temperatures exceed 34 or 35°C — the temperature of the brood area where the young are reared — they fan their wings, ventilating the hive and cooling it by evaporating water. A source of water within the flight range of the bees is essential for this air conditioning as well as for nutritional purposes.

Flight activity is influenced by several weather factors. Wet or cool weather restricts it. Unlike bumblebees, which may gather nectar at temperatures as low as 4 or 5°C, honeybees are not very active in seeking nectar when the temperature is below 16 or 17°C. At temperatures around 10°C, they are unable to sustain prolonged flight. The upper temperature level for foraging is around 38°C. Winds in excess of about 24 km per hour, which approach the bees' maximum flying speed, discourage flight.

Nectar is secreted from tiny glands called "nectaries", which are usually located on the flower, though in some plants they also occur outside the flower. Weather factors may affect secretion directly by acting on processes in the flower or indirectly through processes occurring elsewhere in the plant. Daily nectar yields can differ by as much as 400 or 500% in the course of a few days. Under natural conditions it is sometimes difficult to assess the relative importance of different factors in the weather complex. Sunlight, however, may be considered the most basic because it provides the energy for the photosynthesis of nectar sugar. Figure 1 illustrates the close relationship found between daily nectar yield in alsike flowers and the amount of solar energy recorded at a regional weather station in the previous 24-hour period. The plants were grown in a greenhouse at the Ontario Agricultural College, at Guelph. The daily variation in nectar yield is seen to be around 100%. The influence of sunlight on nectar secretion in plants growing outdoors is often less obvious because of partial masking by other factors. However, records made in several countries have shown an association between sunny weather and good honey crops. A study carried out recently in Saskatchewan, in which honey crops at ten locations were correlated with weather records, showed that sunlight was the most influential factor[2] in 1976. The influence of sunlight on yields of nectar in trees and shrubs, where nectar may come from stored materials, may be less direct than in herbaceous plants. Here the amount of sunlight in the previous season is of importance.

Temperature, with respect to both threshold and optimal range, also influences nectar production. Basswood begins to secrete at about 18°C, and cucumber at 17-21°C. In general, a range of about 21-30°C is probably most favourable for the majority of important Canadian honey plants in the summer months. Nectar plants flowering in the spring, such as willow and maple, are likely to secrete at lower temperatures than those flowering in mid-summer. Extended periods of temperatures above 30°C are often accompanied by drought, which causes a water stress in the plant, thereby reducing photosynthesis and hence nectar production. Late summer frosts terminate secretion and may reduce honey crops from plants such as goldenrod and aster.

The failure of soybeans, a major source of nectar in the central plains of the United States, to yield appreciable quantities of nectar in southwestern Ontario may be a temperature effect.

The effect of rainfall on nectar yield depends on both air temperature and soil type. It is possible to have either too little or too much rainfall, but the former condition is the more common. Long-term records in the United States and in several European countries indicate that years of higher than average rainfall support the best honey crops. Lack of rain limited honey crops in many parts of southern Ontario in 1978. When a dry period is broken by a heavy rain, the effect on honey production can be quite dramatic, but light showers have little effect because they fail to moisten much of the plant's root zone.

Humidity and wind usually affect the concentration of nectar more than the amount produced. After nectar is secreted its sugar concentration increases as water is lost by evaporation. Water loss is most rapid in hot, dry air and is hastened by wind.

The overall significance of weather to beekeeping is seen to be considerable. In the future, climate and weather effects may be more complicated. Recently Dr. McTaggart-Cowan, an eminent meteorologist and now a beekeeper in his retirement, pointed out that in recent decades we have become accustomed to unusually fine weather; world weather in the years between 1940 and 1970 was the most stable of any since weather records were first kept. Now, however, he says we have entered a period when more extreme fluctuations will be normal.

The beginning beekeeper should take weather factors into account in setting up his operation. If his circumstances permit a choice of location, he should look for an area with a long frost-free period, good rainfall in the summer months, and the maximum amount of sunshine in the growing season. This information is readily available from weather records. The apiary site should provide protection from the prevailing wind and should be sunny for as much of the day as possible.

[1]Stroempl, G. 1977: Distribution and use of basswood and lindens for honey production. *Amer. Bee J.* 117(5): 298-301, 322.

[2]Hicks, Grant R. 1977: An investigation into the role of climate in explaining the variation in honey production between various localities in Saskatchewan. Honrs. B.A. Thesis, Wilfrid Laurier University.

Further Reading

Dadant, C.C. and Sons. 1975: **The Hive and the Honeybee.** Dadant and Sons, Hamilton, Illinois.

R.W. Shuel is professor of environmental biology at the Ontario Agricultural College, Guelph University, Guelph, Ontario.

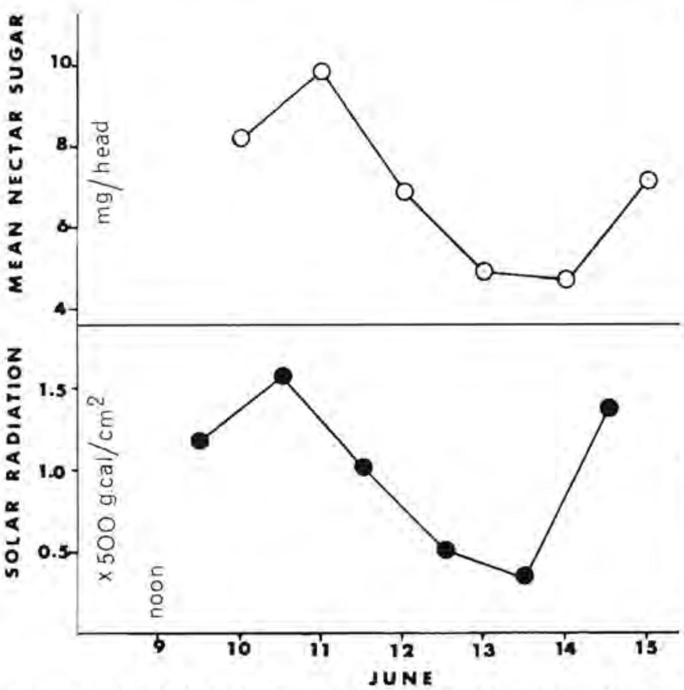
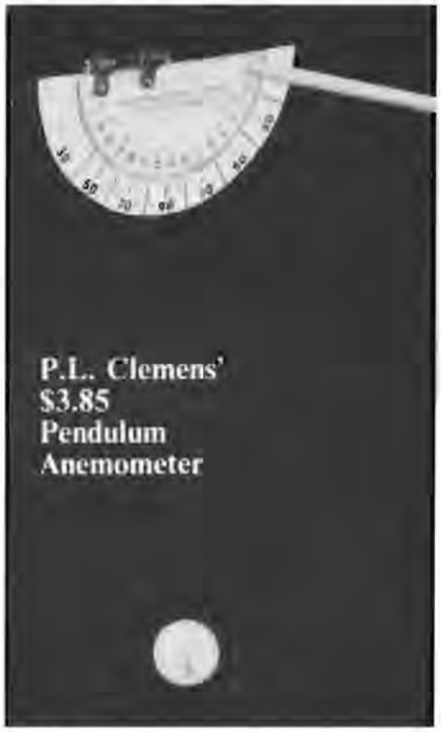


FIGURE 1. THE CLOSE RELATIONSHIP BETWEEN SOLAR ENERGY AND NECTAR YIELD in alsike, a major honey plant in many parts of Canada.

WRAPPING HIVES reduces heat loss in winter.

THE WEATHER AMATEUR



Amazing as it sounds, it is possible to build a simple anemometer for less than $4 that will measure the wind speed with 94% accuracy. You will need the following items:

- one 40 cm length of wood dowel stock (about 1 cm diameter),
- a celluloid protractor,
- a length of monofilament fishing line,
- a ping-pong ball,
- a spirit-level bubble (inexpensive replacement bubbles can be obtained at the hardware store),
- two short stove bolts (complete with nuts),
- two metal straps of the kind commonly used to hold household electrical wiring,
- one small wood screw.

This pendulum anemometer is a modern variation of an idea first attributed to Leonardo da Vinci over 500 years ago. In principle it consists of a plate (or pendulum) which is free to swing about a horizontal axis in its own plane and above its centre of gravity. The wind blows on the plate resulting in motion about the horizontal reference position which varies with the pressure exerted by the wind. A description of such an instrument was published by Robert Hooke in 1667 and his design is generally regarded as the first real anemometer of any kind.

Calibration is the main hurdle which must be overcome in constructing a simple pressure plate or pendulum anemometer. Fortunately for us, the ping-pong ball pendulum design of P.L. Clemens (photo, this page) was calibrated in a wind tunnel, and the results can be transferred to all exact duplicates of the instrument. From the wind tunnel measurements, Clemens derived an equation that expresses the calibration at standard conditions of atmospheric pressure and temperature;

$$u=31.52\ (\cot a)^{1/2}$$

where u is the wind speed in km/h and a is the protractor angle of the pendulum's deflection from the horizontal. When constructing the Clemens pendulum anemometer it is very important to follow the dimensions when given in this article, otherwise the calibration table (bottom right) will not apply. Apart from this stipulation, personal ingenuity can be applied to modify the instrument to suit any particular purpose. In our version for example, we have added a backing card to the protractor which is marked in such a way as to make the scale divisions more readable from a distance.

The construction steps are illustrated by the photos on page 35. The ping-pong ball is pierced at two diametrically opposite points with a needle and the length of monofilament line is threaded through. Tie a small knot in the free end to serve as a seat and secure it to the ball with a dab of cement. Trim off as much of the free end as possible to reduce aerodynamic drag. Thread the other end of the line through the index hole of the protractor and fasten it in a similar fashion. There should be a 30 cm length of line between the index hole and the top surface of the ball. Attach the wooden dowel handle to side of the assembly with a screw so that the face of the protractor is towards the observer. Finally, place the spirit level on the top edge of the protractor and fasten it in place with the straps and bolts. It will be necessary to drill three holes through the protractor to take the screw and bolts. When the pendulum bob is hanging vertically, the levelling bubble should of course be centred. This can be accomplished by holding the protractor-bob assembly in a vice so that the pendulum is exactly vertical with the 90° marking, and then adjusting the level before tightening it into place.

The anemometer is now ready for use, and with a little practice will produce accurate measurements. If it is desired to measure the free undisturbed flow of the wind, an open site free from the turbulence of trees, buildings and other obstructions should be selected. Hold the instrument at arms length so that it is beyond the zone of air disturbed by the observer's body, and align the plane of the protractor with the direction of the wind. All that is necessary now is to take a series of angular measurements over a period of time to obtain an average value, and then use the calibration table to convert the reading to wind speed.

We compared readings from our ***Chinook***-built Clemens' instrument at ground level with those obtained from a commercially built Dwyer Mark II pressure tube wind speed indicator located 10m above the ground. Twenty readings were taken simultaneously from each instrument over a five minute interval with the following results:

	Five minute average wind speed (km/h)	Wind speed range (km/h)
Clemens	19	10-35
Dwyer	23	16-32

Given the fact that wind speed generally increases with height, the results of the test are consistent.

Further Reading

Middleton, W.E.K., 1942: **Meteorological Instruments.** University of Toronto Press, Toronto, p. 132.

Strong, C.L., 1971: **The Amateur Scientist.** *Scientific American*, vol. 225, no. 4, pp. 108-110.

CALIBRATION TABLE

ANGLE	KM/H	ANGLE	KM/H	ANGLE	KM/H
15	60.9	40	34.4	65	21.5
16	58.9	41	33.8	66	21.0
17	57.0	42	33.2	67	20.5
18	55.3	43	32.6	68	20.0
19	53.7	44	32.1	69	19.5
20	52.3	45	31.5	70	19.0
21	50.9	46	30.9	71	18.5
22	49.6	47	30.4	72	18.0
23	48.4	48	29.9	73	17.4
24	47.2	49	29.4	74	16.9
25	46.2	50	28.9	75	16.3
26	45.1	51	28.4	76	15.7
27	44.2	52	27.9	77	15.1
28	43.2	53	27.4	78	14.5
29	42.3	54	26.9	79	13.9
30	41.5	55	26.4	80	13.2
31	40.7	56	25.9	81	12.5
32	39.9	57	25.4	82	11.8
33	39.1	58	24.9	83	11.0
34	38.4	59	24.4	84	10.2
35	37.7	60	24.0	85	9.3
36	37.0	61	23.5	86	8.3
37	36.3	62	23.0	87	7.2
38	35.7	63	22.5	88	5.9
39	35.0	64	22.0	89	4.2
				90	0

THE CALIBRATION TABLE (opposite page) gives the wind speed in km/h for any particular protractor reading. If, for example, the pendulum deflection is 35° then the wind speed (rounded off) is 38 km/h. A dab of coloured paint on the pendulum line where it crosses the scale will make measurement easier.

PHOTO (left) ILLUSTRATES THE MAIN COMPONENTS required to build the anemometer.

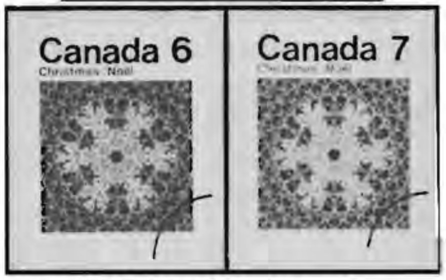
PHOTO (centre left) SHOWS THE METHOD OF PIERCING THE PING-PONG BALL. Draw two lines around the ball to divide it into sets of hemispheres, such that one line is perpendicular to the other. The points where the lines cross are diametrically opposite to each other. Pierce these points, and with a little patience, thread the monofilament line through them.

PHOTO (centre right). THE DOWEL HAS BEEN SCREWED TO THE SCALE ASSEMBLY. Note that the scale faces the observer. If you place it the other way around, an assistant is required to take the readings. Thread the free end of the pendulum line through the protractor index hole (the centre of the scale circle).

PHOTO (bottom). Mark Wegener and Stuart Creaser (left), grade 5 students of Lynngate Junior Public School, Agincourt, Ontario, demonstrate their version of the P.L. Clemens pendulum anemometer.

THE MIRROR

NEWS AND NOTES



METEOROLOGY STUDY UNIT — A FIRST!

Meteorological philately is alive and well, but until now, its many largely unkown followers have been a scattered, unorganized, and a mainly unrecognized facet of the philatelic picture. Yet, there have been hundreds upon hundreds of weather-related stamps, souvenir sheets, first day covers, postal stationery issued through the years. Weather-minded philatelists, beginning or advanced, now have their first opportunity to enter the mainstream of their chosen hobby. A new study group of the American Topical Association (ATA) is forming and is called the Meteorology Study Unit. Those wishing to join need not belong to ATA. Details are available from Michael J. Mooney, 140-10 Franklin Ave. (B44), Flushing, New York 11355, U.S.A.

U OF T STUDENT CONDUCTS MICRO-SCALE WINDFLOW EXPERIMENT

Mark Ockwell is a 5th., year geography student at Scarborough College, University of Toronto. He is specializing in wind energy and for his honours degree thesis is working on a unique micro-scale wind measurement project under the supervision of Professor Hardy Granberg. At a recent Energy Fair in Walkerton, ***Chinook*** interviewed Mark who was exhibiting the field equipment used in his work. He explained that the ingenious instruments on display were designed by Prof. Granberg and built in the College workshop. The exhibit anemometer for example, was built from components such as Ban aerosol lids, a small d-c electric motor and a modified electronic hand calculator. This summer, Mark Ockwell expects to complete his project and write a thesis designed to assist people who wish to site a windmill at a specific location and given particular terrain. Look for an article by him in a future issue of ***Chinook***.

A *VENNOR*ABLE WEATHER PROPHET

by Scott Somerville

"The end has come; our idol has been shattered; never more will we say a good word for him. He is an unmitigated fraud, a monstrous humbug, an abominable cheat; a shameless imposter; he should be suspended from the branch of a dead pine, bareheaded and barefooted, with the breezes of all the cold dips of the next hundred years playing about him in their concentrated intensity."

These sentiments expressed in the *Orillia Times* of February 28, 1878 were reserved, not for a crooked politician, a patent-medicine salesman, or a card cheat, but for the worst of all frauds, a weather prognosticator. No doubt somewhat tongue-in-cheek, the remarks were directed at Henry George Vennor, a man of many talents, who rose to prominence during the autumn of 1875 with a remarkably accurate weather forecast. He wrote a letter to the editor of the *Montreal Daily Witness* confidently declaring that snow would arrive early that winter, but would quickly melt away. Furthermore, Christmas would be green, followed by a muddy New Year's. Much to everyone's surprise he was quite correct. Through November and early December of 1875, the days were very cold and there was heavy snow. On November 30th, Toronto experienced an average daily daily temperature of -18°C followed by a fall of 30 centimetres of snow. By December 19th., true to Vennor's prediction, the temperature rose well above freezing and continued there until early January. New Year's Eve was so mild that Toronto basked in a temperature of 16°C, the warmest day for any December, and a record which remains unbroken to the present time.

In view of this spectacular success, why the humorous invective of the *Times* editorial? It was in fact an example of the scorn heaped upon all weather prophets when their forecasts failed to materialize. In some cases, the derision was richly deserved, and at first glance it may seem that Vennor also deserved such treatment. After all, his predictions also failed from time to time, and in this particular case his reasoning was publicly stated as a "feeling in his bones," hardly a credible basis for such a pronouncement. This intuitive approach to weather prediction was however only a part of his method, for as we will see, he also utilized a system which attempted to base such forecasts upon preceding weather patterns. He reasoned that "weather, of whatever kind must be the natural and necessary consequence of weather which has preceded it." In any event, his astoundingly accurate prophecy delivered him into swift fame.

Henry George Vennor, F.R.G.S., was born in Montreal on December 30, 1840. As a youth he displayed a flair for the natural sciences, which he pursued as a student at McGill University. In 1860, he entered commercial life, working in the Montreal wholesale warehouse of Messrs. Frothingham and Workman, but exhibited no particular love for it. Five years later he enthusiastically accepted an appointment to assist Sir W.E. Logan in a survey of Manitoulin Island. Having found his niche, he laboured in various surveys undertaken by the Geological Commission, and his name was linked to the first discovery of gold in Madoc township north of Belleville, Ontario. Vennor claimed to have spent more time than any other man exploring the wilds of Canada in canoes and on foot. He estimated that he endured about 78 months living in the bush, during which he developed a keen weather-eye. Included among his achievements during this period of his life were his revised classification of old Laurentian rocks and his geological discoveries in eastern Ontario. He also studied wildlife and, in 1875, published a magnificently illustrated volume of ornithology entitled "Our Birds of Prey".

Endowed with a practical understanding of meteorology, and no doubt encouraged by his initial success in predicting the unusual December weather, Vennor published an annual almanac which covered the years 1877 to 1885. In the issue for 1879, he elaborated on his forecast method, explaining that it consisted of three steps. First, he intuitively deduced a forecast for the coming season based upon his outdoor experience. Secondly, and independently from his first conclusion, he derived a trend for the past several months based upon his field notes and the actual weather reported, then he projected this trend forward in time. Thirdly, he established a long term seasonal trend by examining diagrams of weather for the past 30 years which he had posted on his study wall. The final forecast for the coming season was a balance of the results obtained at each step. Writing about this procedure, Vennor explained how "sitting down in my easy chair in the middle of my room, I gaze long and earnestly at the terrible array of weather charts on my wall. Friends come in and go away again, and as I have recently heard, repeat to other friends that 'Vennor occupies most of his time sitting, pipe in mouth, gazing at the wall.' And so he does and so he probably will until the weather problem is solved . . ."

Unlike other weather prophets, he strived for long hours to establish a forecast which pleased him, and such time and energy devoted to this task put him in a different class than other amateurs, many of whom used astrological methods. As he himself said, "I hate the word prophet." The technique of using the evolution of past weather events as a model, or analog, for the outcome of present events, is in use today. Naturally, modern computers can store and analyze vast quantities of historical data, so that it is indeed noteworthy that Vennor was able to achieve success from time to time with the limited information and facilities available to him.

It is true of course that his probabilities were somewhat vague, a fault still commonly noted in present day publications such as the *Farmer's Almanac.* Statements such as "rainy days will be exceedingly few" or, "there will be some heavy falls of snow but much of the month will be clear and fairly cold", are to be found in *Vennor's Almanac.* Not only are such forecasts of marginal usefulness, but are also susceptible to exaggerated claims of veracity after the event. Such probabilities however represented only a small portion of the Almanac. There were many tid-bits of information related to the natural sciences. These included notes on astronomy, weather instruments, ball lightning, agriculture and wildlife, and even some poetry. One rather singular article entitled "Poking Fun at Vennor" indicated that he had a sense of humour, and detailed various criticisms printed by the press over the years. In the case of the *Toronto Globe,* he was able to turn the tables by pointing out that in one particular case they had published and lampooned extracts from his Almanac, but for the wrong year! When he was correct, he was not above patting himself on the back with such statements as "a remarkable January, but precisely as predicted." When he was wrong he would go to great lengths to elucidate the unusual nature of the event, such as the stormy summer of 1878 when he had poor luck with his predictions.

Dr. Joseph Workman (***Chinook,*** Winter 1979) was one of Vennor's severest skeptics, and had a habit of pasting a Vennor prediction in his journal besides one of his own radically different observations. The Doctor would often scrawl sarcastic comments on the clippings, for example one Vennor article was entitled "Watch This", on which Dr. Workman wrote "I have, Mr. Vennor had better shut up." It is not clear why the two men were at odds with each other because each of them was dedicated to observing the weather and they devoted much of their life to understanding it better. Dr. Workman's attitude appears to have been somewhat stern and authoritarian, and it is reasonable to assume that he did not approve of Vennor's more liberal interpretation of weather events, and viewed his forecasts as unscientific.

Unfortunately Henry Vennor was afflicted by a spinal disease and suffered a rather slow death. He passed away on June 8, 1884 at the relatively young age of 43. In spite of his illness he managed to produce probabilities for 1885 which Walter H. Smith, a close friend and colleague, incorporated into the last issue of *Vennor's Almanac.* Admittedly Vennor's forecasts aroused controversy, but his method was reasonable and his motivation was sound. His Almanac provided people with useful and stimulating reading and commanded respect at a time when the country was flooded with trashy publications of a similar nature.

Perhaps the last word should be left to a Vennor supporter who wrote in an article published by the *Toronto Mail,* in 1878, "one can hardly imagine a more fickle jade than the weather, to bring under any settled code of etiquette."

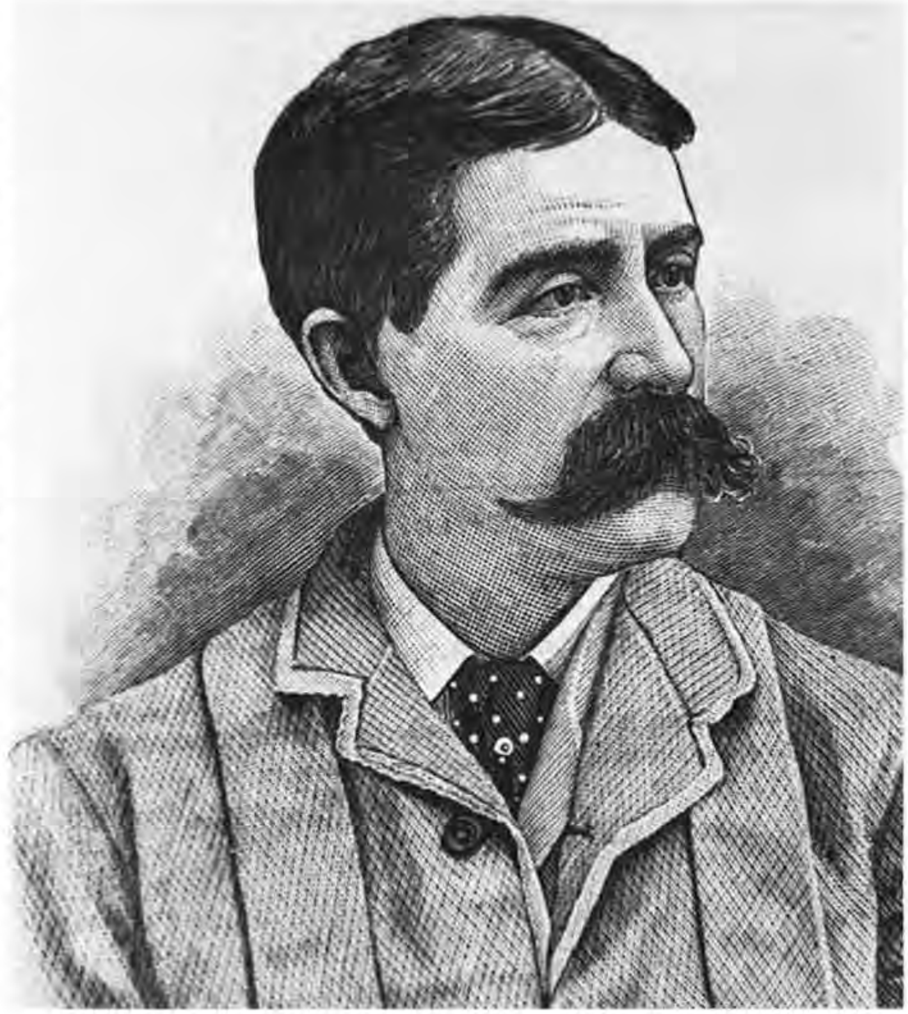


PHOTO (above). HENRY G. VENNOR, F.R.G.S. 1841-1884. An engraving by Walker from a photograph by Notman.

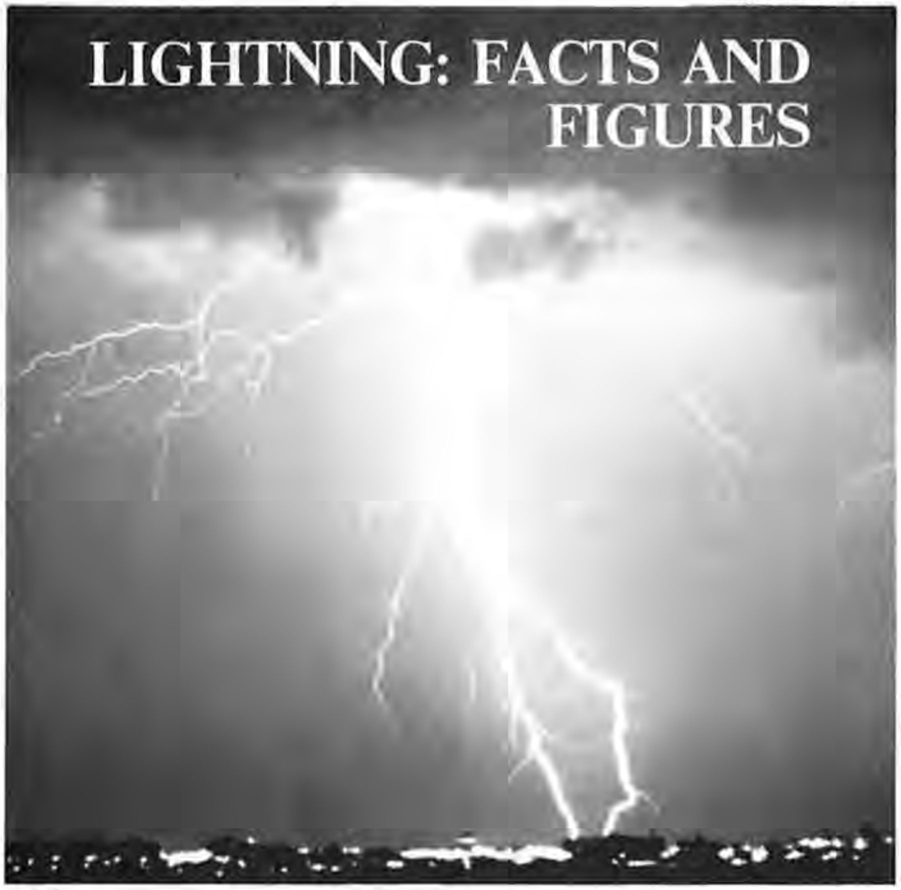
PHOTO (far right). THE ATTRACTIVE FRONT COVER of Vennor's Weather Almanac for 1883 by an unknown artist. The design changed from issue to issue and occasionally so did the publisher, who in this case was A. Vogeler & Co., Toronto. Besides being symbolic of wisdom, the owl was probably also chosen because Vennor, as an ornithologist, had a great interest in birds of prey.

PHOTO (right). THE TITLE PAGE of the 1883 Almanac.

COLLECTION METROPOLITAN TORONTO LIBRARY

ARJEN VERKAIK

LIGHTNING: FACTS AND FIGURES



From mine shafts to the first Zeppelin, almost every location on, above and even below the Earth is prone to the whims of lightning. J.B. Allenby was asleep in his bed on the night of May 19, 1898 when lightning struck his home in London, Ontario. Everyone awoke and finding themselves unharmed, hastened to his room where they were horrified to find him lying in bed with his whiskers and hair ablaze[1]. On June 15, 1860, a willow tree near Galt, Ontario was struck by lightning and shattered. Close by was a stream and hundreds of dead fish covered the surface where the lightening charge had been conducted by the tree roots, while nearby, in a field, a man was paralyzed by the shock[2]. Near Tanaga, Quebec, a boy was struck and killed by lightning while swimming in the Gatineau River on July 7, 1976[3]. In August 1975, Delmer Alexander of Gravenhurst, Ontario, was killed when lightning hit water pipes while he was fixing a water pump in the basement of his home[4].

Unpredictable and often bizzare in its results, lightning is second only to excessive cold as a natural killer in Canada, and apart from those started by man's activities, it is the largest single cause of forest and other fires. As many as 30 or 35% of all forest conflagrations in any given season can be due to lightning strikes, although the proportion in the case of property fires is smaller, amounting to 1 or 2% of the total number.

Q. WHAT IS THE MORTALITY RATE DUE TO LIGHTNING IN CANADA?

A. From 1939 to 1960 there were 344 fatalities, and from 1969 to 1976 there were 78[5]. Only the Yukon and the Northwest Territories have a fatality-free record. Figure 1 (p. 39) compares the average number of lightning caused deaths per year to the average number of thunderstorm days (a day on which thunder is reported) per year. Both increasing latitude and proximity to ocean areas control the amount of thunderstorms, and the maritime areas of the east and west coasts as well as the northern territories have fewer thunderstorm days, and therefore fewer lightning deaths, than the interior of Canada. To some extent, Fig. 1 is misleading because it does not take population into account. It indicates that Ontario and Quebec have the greatest number of fatalities which is due no doubt to their large population. On a per capita basis, the death rate is actually greatest in Saskatchewan with 2.8 deaths per year per million of population. Alberta is second with 2.0, followed by Manitoba 1.8; New Brunswick 1.4; Ontario and P.E.I. 1.0; Quebec 0.9; Nova Scotia 0.6; and Newfoundland and British Columbia last with 0.2.

Q. WHEN IS THE GREATEST CHANCE OF BEING STRUCK BY LIGHTNING?

A. Thunderstorms are most common in July and lightning fatalities are naturally closely linked to their seasonal variation. Chances of being struck are greatest during the months of June, July and August when 84% of fatalities occur.

Q. WHICH IS SAFER, A RURAL OR A SUBURBAN AREA?

A. Rural deaths outnumber urban deaths by over 4 to 1. Rural residents are more likely to be caught in a dangerous location where safe shelter is not always convenient. The predominantly rural nature of human activities in the prairie provinces is very likely the reason why the lightning death rate is greatest there.

Q. IS IT POSSIBLE TO TELL BEFOREHAND WHETHER LIGHTNING IS ABOUT TO STRIKE?

A. Sometimes. Just before a lightning flash, the ground beneath the thunderstorm cloud is deficient in electrons, or in other words it carries a strong positive electric charge. Tall objects (perhaps a person in an open area) are the most charged of all, and may be crowned with corona as intense ionization occurs. In a person, this may produce a tingling feeling, premonition, apprehension or gooseflesh; hair stands up on end and the tips of hairs may be scorched all over the body; the face may be lit up by purplish light and there may be nerve or muscle stimulation resulting in minor contractions. If this should happen, immediately minimize your height and area in contact with the ground by kneeling down, placing the hands on your knees and lowering your head — don't lie flat. Whether you are religious or not, a prayer might be in order at this time.

Q. WHAT ARE THE EFFECTS ON SOMEBODY WHO IS STRUCK BY LIGHTNING?

A[6]. (a) Sudden firm contraction of the muscular fibre and main arteries, sometimes permanent contraction of the heart; (b) depletion of oxygen in the spinal cord and fibre resulting in cessation of breathing; (c) large necroses at the points of entry and exit of the flash if it penetrates the body; (d) if the flash runs over the skin it will burn the epithelial layer and leave characteristic arborescent markings (see photo p. 39). There are often surface burns, usually beneath metals such as watches, keys, coins, buckles etc., and the objects themselves wholly or partially fused from the heat due to electrical eddy currents; (e) the air between the body and clothing expands suddenly with explosive force. Clothes, belts, boots etc., are burst and thrown off, and shock is suffered due to the noise of the thunder caused by the explosion; (f) eyes are temporarily blinded by the flash.

Q. DOES LIGHTNING EVER STRIKE TWICE?

A. Yes. Trees, towers and buildings in exposed or prominent locations are frequently subjected to multiple strikes. It was a succession of strikes in the same spot which caused Canada's worst lightning tragedy. The Red River news section of the *Nor'-Wester* of August, 1863 carried the following item;

"Sometime ago a report reached us that 30 or 40 indians had been killed by lightning while encamped on the plains in the vicinity of Touchwood Hills (just north of Regina, Sask.). We did not credit the story, however, and gave it no currency. But we have since heard it confirmed on good authority. The indians report that a great thunderstorm came on and that the lightning fell several times in quick succession, killing between 30 and 40 persons in the camp. We have not heard the exact number".

At this point it must be emphasized that the chance of being hit by lightning in Canada is literally one or two in a million. Loss of life by fires not attributable to lightning is forty-five times more likely. Many people struck by lightning do not in fact take the full charge, and although apparently dead, can be safely handled by a rescuer and revived with artificial respiration. There are of course a number of precautions which can be taken to minimize still further the chance of being hit. The examples given earlier illustrate the dangers of being in contact with good electrical conductors during a thunderstorm. Rule number 1, avoid conductive objects, or large, non-grounded metal objects in which induced currents can build to lethal levels. For these reasons, the following can be very dangerous and contact with them should be avoided; an open tractor which is grounded by an attached earth working implement; electrical appliances, telephones, plumbing (it is connected to metal vents which protrude above the roof); open water; tall or isolated trees or poles; wire fences or railroad tracks (they carry charge a long distance from a lightning strike); an isolated or unrodded farm buildings. Rule number 2, minimize your chance of becoming a lightning rod. If you are in an exposed location, don't carry a fishing pole or golf clubs. Seek out a low area of ground or a densely treed location if you cannot reach a large building or your car. Avoid high or exposed points. If you are caught in a small boat, crouch down in the centre to avoid becoming the path of least resistance to the water.

You may be petrified of lightning but there are ways to avoid being petrified by it, furthermore you can console yourself with the thought that if you heard the thunder then the lightning didn't strike you, if you saw the lightning then it missed you, and if it did strike you then you wouldn't know it[7].

[1]*The Globe*, Toronto, May 20, 1898. [2]Ibid, June 25, 1960. [3]*The Toronto Star*, July 8, 1976. [4]Ibid, August 27, 1975. [5]Causes of Death, Catalogue 84-203 Annual, Statistics Canada. [6]Shipley, J.F. and Barnes, P.E. 1940: Injuries caused by lightning. *Quarterly Journal Royal Met.* Soc. vol. 66. [7]Karl McEachron as quoted by P.E. Viemeister (see further reading).

Acknowledgements

Many of the statistics are those of R.A. Hornstein (see further reading). Historical research by P.J. Elms.

Further Reading

Day, W.H. 1916: **Lightning. Its nature and the efficiency and methods of lightning protection.** *Journal of the Royal Astronomical Society of Canada,* vol. 10, pp 121-133.

Hornstein, R.A. 1961: **Lightning Deaths and Damage in Canada.** CIR 3452, TEC 349, Meteorological Branch, Dept. of Transport.

Hornstein, R.A. 1962: **Canadian Lightning Deaths and Damage.** CIR 3719, TEC 423, Meteorological Branch, Dept. of Transport.

Viemeister, P.E. 1961: **The Lightning Book.** Doubleday and Company, Garden City, New York.

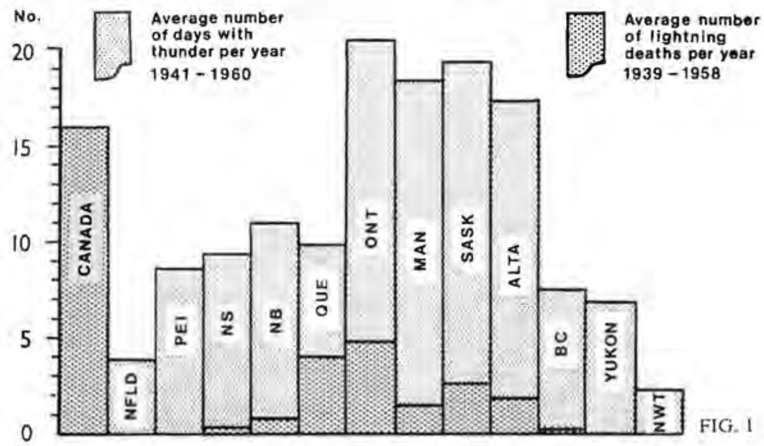


FIG. 1

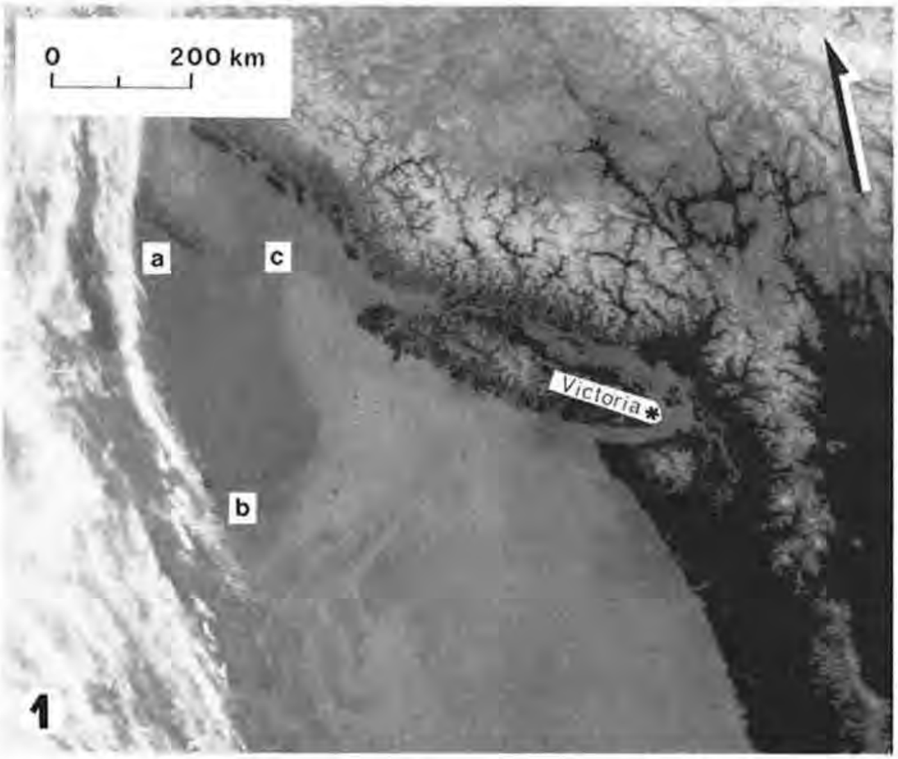
FIG. 1 (top). A COMPARISON OF THE AVERAGE ANNUAL NUMBER OF LIGHTNING DEATHS (in red) AND THUNDERSTORM DAYS IN CANADA during a 20 year period. The yearly lightning death toll for the whole country stands at an average of 16, or approximately 1 death per million of population.

PHOTO (left). ARBORESCENT MARKINGS on the skin of a lightning victim who was struck while sheltering under a tree. Contrary to old wives' tales, such patterns are not shadows of the tree under which the victim took refuge.

PHOTO (right). A LIGHTNING SCAR spirals down to ground through the bark of a tree.

WINDOW ON WEATHER

Ships or planes? Pictures relayed by the NOAA5 weather satellite sometimes show anomalous lines which remain something of a puzzle to meteorologists. An example of these lines can be seen most clearly in picture number 2, in which visible light was utilized to photograph the scene 1400 km below on April 5, 1977. Showing as highly persistent cloud lines over the Pacific, to the south-west of Vancouver Island, the tic-tac-toe pattern is clearly unrelated to any normal atmospheric circulation, and must be of man-made origin.



PHOTOS COURTESY AES

Picture number 1, taken simultaneously by the satellite's infra-red radiometer, yields useful information about the same area. Clear skies prevail over the land areas, and the interior valleys of British Columbia as well as the lower terrain of Washington are much warmer (darker) than the ocean surface (a much lighter gray shade in the cloud free zone **abc,** west of Vancouver Island). Fog shrouds the water from the tip of the island and southwards, but dissipates along a very sharp eastern boundary where it meets the much warmer land surface. It is clearly visible in picture 2, but is difficult to pick out in picture 1 because its temperature is only a little colder than the ocean. The white north — south streaks bordering the left edge of the infra-red picture indicate high, and therefore cold, clouds at an altitude well above the fog.

The bright anomalous lines hardly show in picture 1 because they are at the same temperature as the fog, and must therefore be a low level phenomena — most likely due to ships since planes that far away from land would probably be high-flying international flights. A more detailed examination reveals that some of the lines curve at their eastern end and narrow to a point source. This suggests that they are contrails left by a moving object, particularly since the alterations in course appear to be towards the Strait of Juan de Fuca, the gateway to the major ports of B.C. and Washington. The thickest lines are about 8 km wide while the longer ones stretch more than 400 km. If they are indeed concentrations of condensed moisture caused by the trail of particles emitted from smokestacks, then they must have persisted for about 13 hours or more if we assume a ship speed of about 30 km/h.

Normally, mixing of the atmosphere due to the wind would cause such contrails to disappear very quickly, if they formed at all. In this case however, the huge fog bank implies that winds are very light, and consequently a considerable period of time would be required before distortion appeared in the contrails. This is just what the pictures show. Only at their western-most end do the lines begin to deviate from their smooth, regular path.

It seems that these pictures from space give clear evidence of human activity, presumably the motion of ships at sea. Do you have another explanation?

PAST WEATHER

THE BROCKVILLE LIGHTNING DISASTER

The *John B. King* was a drill-scow, a type of boat viewed with disdain by other mariners who plied the St. Lawrence River. This ugly duckling, owned by J.P. Porter & Sons of St. Catherines, was nothing more than a huge floating drill platform 140 feet long and 50 feet wide that was manned by a landlubber crew of 42 men. Sporting 12 drills, each capable of boring 10 inch diameter holes 30 feet deep into the river bottom bedrock, the *John B. King* was stabilized by two giant timber spuds 65 feet in height and 36 inches square, which could be lowered to the river floor.

On June 26, 1930, the scow and complement were working in the portion of the St. Lawrence known as the Brockville Narrows. J.P. Porter & Sons had been awarded a contract by the Department of Public Works to remove a number of shoals from this area to accomodate the large ships which were expected to come down to the terminal at Prescott once the Welland Ship Canal was opened. Most of the crew of laborers, drillers, blacksmiths, firemen and cooks were working under the direction of the day-shift foreman Bill McNeill, while the members of the night-shift were sleeping in quarters below the water line. Their task was to complete nine more drill-holes which would be filled with a total of 3 tons of polar forcite, a powerful explosive whose chief ingredient was nitroglycerine and capable of smashing several hundred tons of rock.

The drill-ship was moored to four heavy timbers fifty feet long each driven by a piledriver into the river bottom. Two steel cables were secured to pine trees on the west side of nearby Cockburn Island. The men, working in sweltering heat, had finished loading the holes and were making ready to cast off in order to allow the illfated drill rig to drift well away from the blast zone. They looked upon impending storm clouds and nearby rain as a welcome relief from the heat wave of the past 48 hours. The electrical disturbance was the first experienced in the Brockville and Thousand Islands district in several weeks.

At 4.50 p.m. EDT., without warning, a searing flash of lightning struck the bow, jumped the detonating wires and exploded the dynamite beneath the ship. Before the horrified gaze of eyewitnesses ashore, the craft was split asunder and wreckage hurled many hundreds of feet into the air. The shores of the island and the adjacent mainland were strewn with wreckage and oak timbers 12 to 15 inches thick torn from the side of the *John B. King*. Leo Marion, a government inspector, was in the cookhouse when a blinding flash lit up everything around. A terrific roar followed and the next thing he knew, he was high in the air with the debris of the boat and flying rocks beneath him. Later, from his hospital bed, he told a *Globe and Mail* reporter about his incredible survival experience.

"Although I was only in the air for a second, it seemed hours. The next thing I knew, I was scrambling beneath the waters of the St. Lawrence River in an attempt to bring myself to the surface. I must have been underneath the boat, for my lungs were bursting and I could hardly swim, I felt so weak. I finally saw daylight but timbers obstructed my efforts to get to the surface. Pushing them aside, I finally found myself in open air."

The shock of the explosion severely jolted the United States Coast Guard revenue cutter CGQ-11 which was about one-half mile away. Captain G.B. Lok, the vessel's commanding officer, had a clear view of the lightning and a second later heard the terrible explosion. Ordering full speed ahead, he closed in to lower lifeboats and pick up survivors struggling in the water. All told, he pulled 11 frightened, injured men to safety. Thirty others, some of them trapped below-decks with no chance to save themselves, went to the bottom. Only two bodies were recovered, the others were buried by tons of rock loosened by the blast and could not be freed by divers working in the treacherous, fast-flowing undercurrent 50 feet below the surface.

The odds against such an accident as this must be very large, yet amazingly, this was the second time that a dynamite-laden drill-boat had been blown to bits in such a fashion. In 1912, it was reported[1], a drillboat in the Thousand Islands area exploded, fortunately with no loss of life, although 12 workers were sent to hospital. Yet another tragedy involving dynamite exploded by lightning occurred near Rouyn, Quebec on July 11, 1932. In this case, 2 men were killed instantly at the Beattie gold mine in Duparquet Township. The miners J.H. MacDonell and Hugh D. MacDonald, had finished connecting electric wires to dynamite detonating caps 200 feet underground and were preparing to leave for safety on the surface to allow the blast to proceed. Lightning suddenly struck near 2 locked safety switches at the top of the mineshaft and either jumped them both, or else struck inside the shaft below the second switch and detonated the dynamite in the mine before the men were clear.

For more about lightning see LIGHTNING: FACTS AND FIGURES on page 38.

[1]*Globe and Mail*, Toronto, June 27, 1930, p. 2.

CLASSIFIED

Classified ad rates are 50 cents per word with a ten word minimum. For 2 or more insertions, rates are 40 cents per word. Classified display $50 per column inch, same ad 4 times — $40 per col. inch. No agency commissions or cash discounts.

Box numbers, telephone numbers and postal codes count as two words; abbreviations are one word. Cheque or money order must accompany copy, please type or print clearly and include your name and address.

Closing date is 10th of month preceding publication (June 10 for Summer issue). Chinook, PO Box 427, Brampton, Ontario, L6V 2L4

BOOK/PERIODICALS

PRECIPITATION IN ONTARIO by Roger Smith. 160 pages. $12 per copy, 10% discount on orders for 6 or more copies.

A study of precipitation events and techniques for forecasting precipitation amounts and areal coverage in Ontario. Based on 3 years research using almost a century of data. Focusses on the 72 hour time-frame, with a chapter on long range forecasting.

MEP Company, 850 Magnetic Dr., Downsview, Ont., M3J 2C4.

GAMES

WEATHERWITS IS AN EDUCATIONAL METEOROLOGICAL GAME which has been designed for use at school and at home. It simulates the Canadian Weather Service by allowing each player to become a weather forecaster. Players predict how weather will affect lifestyles in their communities on the basis of a morning weather observation. Players score points for correct forecasts. Incorrect predictions may be punished by a trip to Frobisher Bay.

There are only 125 copies of the WEATHERWITS limited edition left. Order yours today. Forward your name, address and cheque for $5.75 (includes sales tax) to THE SCIENTIFIC DIMENSION, 26 Hoover Dr., Thornhill, Ont. L3T 5M7.

TO THE EDITOR from page 31

MAXIMIZING THE USEFULNESS OF AEROGENERATORS

I would like to make a few observations regarding aerogenerators. In your article "Wind Power Generation in Ontario" (***Chinook,*** Fall 1978), I read that according to the Betz Theorem it is not theoretically possible to extract more than 59.3% of the energy contained in the wind given a 100% efficient wind generator. Because aerogenerators used today are not 100% efficient, the net energy produced will be even less. If the Betz Theorem is an established fact, the only thing that can be done is increase the efficiency of the aerogenerators. In this connection I have a few suggestions, but as I am not an expert, I ask for your indulgence.

(a) Concentrate wind-generating systems on top of mountains and use power transmission lines to transport the electricity.
(b) Construct wind-funneling structures in strategic locations.
(c) Use the principle of the old Dutch windmills, but in more sophisticated form.

Perhaps these ideas have been considered already and proven inadequate, but I wanted to pass them on to you just the same.

Mrs. Elly de Jongh
Secretary, Edmonton Chapter, Alberta,
National and Provincial Parks Association of Canada.

LA RIVIERE TORNADO

While organizing my material I came across several copies of the photo of the La Riviere tornado (cover, ***Chinook,*** Fall 1978). The picture was taken by an uncle of Den Van Cauwenberghe who was visiting his relatives from Holland or Belgium.

The width of the funnel base can be guaged from the telephone poles, one on the horizon to the right of the buildings, and the other just in from the left side of the funnel base. These poles would be about 300 feet apart, so that would make the base about 800 feet in diameter.

There were pictures published in the Winnipeg papers, showing another funnel on the same day, which exploded a box car into pieces.

A. F. Davies
Downsview, Ontario

ANSWERS TO ARCH PUZZLES 1 AND 2 (Winter 1979 issue)

1. WIND, Mind, Mint, Mist, Must, GUST.
   DEW, Dee, Dye, Aye, Ace, ICE.
   CLOUD, Clout, Flout, Flour, Floor, Flood, Blood, Blond, Blind, Blink, Slink, Stick, Stock, Stork, STORM.

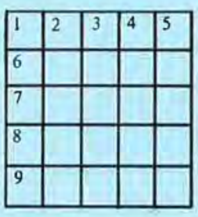
If you answered any of these in less turns, send in your solution and we will publish the shortest.

2. Thermodynamic, Rudolph Diesel.

by
R. G. Stark
(answers next issue)

3. YEARS
   A trio of problems dealing with years.
   (a) What happened or will happen in each of these years: 1772, 1868, 1908, 1964, 1992?
   (b) What is the same about these: 1793, 1838, 1919, 1964, 1982, 2099?
   (c) What can you do with these: 808, 1001, 1111, 1691, 1881, 1961?

4. A CROSSWORD WITHOUT BLANKS



CLUES

Across
1. Shown on a weather map by red, blue or purple.
6. The World Meteorological Organization's code for the type of aviation forecast in 2 down.
7. Far out.
8. Arctic sea smoke is this kind of fog.
9. These may be carried on an overnight expedition.

Down
1. Sometimes this type of weather warning is issued.
2. The way.
3. The weather forecast is ________ right.
4. Fast (two words).
5. Consonants from ancient Greek triremes.