AVALANCHE NEWS NO. 19

NOVEMBER 1985

EDITORIAL NOTE

The intention of AVALANCHE NEWS is to assist communication between persons and organizations engaged in snow avalanche work in Canada. Short articles cover reports of accidents, upcoming and past events, new techniques and equipment, publications, personal news, activities or organizations concerned with avalanche safety, education and research. Contributions are expected from the readers.

AVALANCHE NEWS is issued three times per year, usually in February, June and October. There is no subscription fee. Requests for copies and notifications of changes of address should be sent to the publisher.

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AVALANCHE NEWS

Canadian Avalanche Association, 3904 West 4th Ave., Vancouver, B.C., V6R 1P5

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NEGLIGENCE IN CAUSING AN AVALANCHE ACCIDENT

Submitted by Peter Schaerer

On February 23, 1981, three skiers lost their lives in an avalanche during a helicopter ski week in the Purcell Mountains. Subsequently, the families of the deceased sued the helicopter ski company and the guide for loss and damages. In the trial in the Supreme Court of British Columbia in May and June 1985, the Honourable Mr. Justice Gould found liability against the defendants (Lowry and Rondeau against Canadian Mountain Holidays). I wish to draw attention to several points that are of significance to avalanche hazard forecasters.

The circumstances of the accident were as follows:

Owing to clear, cold weather in January 1981 a weak layer had formed at the snow surface in the Columbia Mountains and the Southern Rocky Mountains. It covered an old rain crust in some areas. Between February 12 and February 21, deep new snow fell on top. A total of 185 cm of new snow, which settled to a depth of 80 cm, was measured at the weather station 10 km from the accident site. Numerous avalanches were observed at the peak of the snowstorm on February 17, scattered and diminished activity occurred on succeeding days, and no activity was observed on February 21 and February 22.

On the morning of February 23, four groups, each consisting of a guide and nine clients, skied the Sundance run once. Poor flying weather then forced them to the other side of the valley. After lunch the weather broke and allowed the helicopter to return to Sundance. The first group skied the run without incident, but when the second group traversed a bench slope along the line used in the morning, an avalanche broke off higher on the slope. The guide and one client reached a shallow ridge where the avalanche split and flowed around them. When the avalanche came to rest, five skiers were partially buried and either could free themselves or were dug out by others. The three other victims, who were completely buried, were located by transceiver within ten minutes, dug out within thirty minutes, but doctors on the scene pronounced them dead.

The aspect of the avalanche path was west and a south-westerly cross wind had deposited snow behind a shallow rocky ridge in the starting zone the previous day.

The plaintiffs case rested on negligence with respect to avalanche hazard forecasting. The counsel for the plaintiffs submitted that the guides of the skiing parties should have known from the weather of the previous days, snowpack observations, and avalanche occurrences that unstable conditions existed, therefore should not have led their clients across the Sundance avalanche path. In his written judgement, the judge found negligence on the part of the ski company, the particulars of which are:

1) "Failure to take any kind of snow profile in the vicinity of the Sundance Run".

2) "Failure to interpret reasonably and competently available evidence that indicated avalanche activity propensity at Sundance, evidence such as the fact that Sundance had not yet discharged by natural avalanche, recent buildup of snow, as had some other sites in the area".

It became evident during the trial that on the day of the accident the guides were misled by signs of stability at the surface - such as a high rate of settlement of the storm snow, low surface penetrability, very light snowfall in the past two days, temperatures in the range of $0^{o}C$ - $6^{o}C$ during and after the storm, no observed natural avalanches for two days - but they had not realized that the weakness about 80 cm below the surface was still present. A test profile at the high level weather station or closer to the avalanche paths would have revealed the lingering deep instability. The skiers crossed the avalanche path where the incline was only 15^{o} to 20^{o}, but a local failure propagated under the well settled windpacked snow. The fracture occurred about 500 m slope distance and 260 m difference in elevation above on an incline of 48^{o}.

The second point of negligence determined by the Court concerned the fact that adequate attention was not given to signs of recent snow drifting which had loaded the starting zone of the Sundance avalanche.

The unfortunate accident is a reminder that snow stability evaluation must not be based on a few quick observations, but must take into consideration a whole set of factors in combination.

I wish to bring to the attention of professional avalanche safety personnel additional observations which I made while attending this trial and previous Coroners' Inquests.

When being called as a witness, avalanche technicians and guides must be prepared to explain in court in layman's terms how they evaluate snow stabilities and avalanche hazards. The explanation that snow stability analysis and decision making is based on intuition may not be acceptable.

The records of weather observations, snow profiles and avalanche occurrences are introduced as evidence, and it is important that the weather records are complete and the snow profiles accurate (they were in the case described). In addition, field book notes are discoverable and must be produced on request of the Court. Legal counsels read carefully the guidelines for observations and avalanche handbooks and during cross-examination may question why recommended observations and actions were omitted. The Witnesses must be prepared to account for them.

Negligence can be found when actions are not carried out that should have been applied according to current standards and professional practice: for example, not wearing transceivers, not spacing out across an avalanche path, neglecting to choose safe terrain when the snow is unstable, not observing snow profiles. Accidents may still happen, but it is difficult to prove negligence when current practice has been applied.

MOUNTAIN WEATHER FORECAST

Submission by Pacific Weather Centre

During the winter months (November through April), forecast guidance for avalanche control and for other weather-sensitive activity in the mountains of British Columbia, is produced by the Pacific Weather Centre. This winter the Mountain Forecast Bulletin will be issued four times daily for the Pacific Weather Centre area of responsibility. The times of issue are 4:00 a.m., 10:00 a.m., 3:00 p.m. and 7:00 p.m. The forecast period is 36 hours. The content consists of:

1. Synopsis: to be technical in nature describing weather systems in the following manner:

   Description

   - front, high, low, trough, etc.

   Motion

   - positions at beginning, mid-point, and end of forecast period

   Development

   - intensification or dissipation (if significant)

2. Freezing Levels: (in metres above sea level)

   - related to weather systems if practicable, but could also be described in terms of geography or the mountain forecast regions

3. Precipitation: usually described in terms of intensities using the following categories:

   - nil
   - light - 1 to 5 mm (in cm for snow) per 24 hours
   - moderate - 6 to 15 mm (in cm for snow) per 24 hours
   - heavy - 16 to 30 mm (in cm for snow) per 24 hours
   - very heavy - more than 30 cm (in cm for snow)

   Precipitation forecasts should be provided for each of the Mountain Forecast regions, though regions can be combined in many cases. Also, in situations where there is sufficient confidence for the provision of greater detail, regions can be subdivided. Where appropriate, timing of the onset or ending of precipitation should be provided. Precipitation type (snow/rain) is normally implied through the freezing level forecasts.

4. Wind: if strong winds (greater than 50 km/hr), or significant deviations from the CMC forecast values are expected, then it will be mentioned.

5. Confidence: if confidence is low, then reasons for the uncertainty, or alternate scenarios should be presented.

6. Amendments shall be issued when required. The criteria includes:

- timing - change of 6 or more hours
- intensity - change to or from "heavy"
- wind - over 50 kmh if not forecast
- freezing level - deviation of 500 metres or more

LIST OF WEATHER OFFICES

OCTOBER 1, 1985

OFFICE	TELEPHONE	OPEN HOURS (LOCAL TIME)
CASTLEGAR	365-3131	0615-1615
KAMLOOPS	376-2160	0700-1700
KELOWNA	765-6598	0445-0015
PENTICTON	492-0539	0700-1700
PORT HARDY	949-6559	0700-1700
PRINCE GEORGE	963-7552	0445-2115
REVELSTOKE	837-4164	0400-2200
TERRACE	635-3224	0710-1710
VANCOUVER	276-6109	24 HOURS
VICTORIA	656-3131	24 HOURS
PACIFIC WEATHER CENTRE, VANCOUVER	666-2728	24 HOURS
BANFF, ALBERTA	403-762-2088	0600-1700
ALBERTA WEATHER OFFICE, EDMONTON	403-468-7931	24 HOURS

(The Pacific Weather Centre is the main contact during hours when the local weather offices are closed).

AVALANCHE COURSES

Training courses for persons working in operations concerned with avalanche safety will be organized again for this coming winter. The courses are a joint venture between:

a) The National Research Council - responsible for the content of the courses;

b) The British Columbia Institute of Technology - responsible for the administration;

c) The Canadian Avalanche Association - responsible for the standards and training objectives.

The following courses are planned for the 1985-1986 winter:

Avalanche Safety for Transportation and Industry - Level 1

November 25-29, 1985	Creston, B.C.
December 2-6, 1985	Creston, B.C.

Avalanche Safety for Ski Operations - Level 1

December 7-13, 1985	Whistler, B.C.
January 12-19, 1985	Assiniboine Provincial Park
January 19-26, 1985	Assiniboine Provincial Park

Avalanche Safety for Ski Operations - Level 2

January 20-27, 1985	Lake Louise, Alberta

Avalanche control and terrain courses are not planned owing to a low response to these courses in the past two years. Such courses could be held, however, if the industry expresses a demand. Control courses, for example, could be organized as in-house courses for ski areas.

Information, brochures and registration forms may be obtained from:

Part-time Studies
School of Engineering Technology
British Columbia Institute of Technology
3700 Willingdon Avenue
Burnaby, B.C.
V5G 3H2

Telephone: 604-432-8521

Applicants for the Level 2 course must have the following prerequisites:

1) Level 1 NRC/BCIT course or equivalent.

2) One full winter or a total of 100 days field experience by making observations of the weather, snowpack and avalanches since taking the Level 1 course.

3. Familiarity with the Canadian guidelines for observation of weather, snowpack and avalanches.

The applicants must submit a resume of their field experience with location, dates and references.

CANADIAN AVALANCHE RESCUE DOG ASSOCIATION

Submission by Rod Pendlebury
President, CARDA

Two training seminars, sponsored by the Canadian Avalanche Rescue Dog Association (CARDA), are scheduled for the upcoming winter season:

December 1-4, 1985	Whistler, B.C.
April 3-6, 1986	Fernie, B.C.

Instruction at these four day sessions is provided by R.C.M.P. and Parks Canada dogmasters and local veterinarians. Information can be obtained by contacting one of the following:

CARDA
Box 364
Fernie, B.C.
V0B 1M0

Telephone: 604-423-7932

Bruce Watt
Box 397
Pemberton, B.C.
V0N 2L0

Telephone: 604-894-6262

Members of CARDA will receive full course information in their fall newsletter.

Other Indicators: A tone will be heard each time the Echo 100 is turned on to indicate that it is functioning. A visual indicator will light with each transmit pulse.

Price: Expected price to professionals is $225.00 U.S.

RAMER ECHO 30

A simplified economical version of the Echo 100, called the Echo 30, will also be available. It will retain all the significant features of the Echo 100, except for the following: transmit range 30 metres (no long range feature), non-rechargeable 9 volt battery, simplified receive range control switch, no visual transmit indicator. Expected price to professionals is $125.00 U.S.

COMMITTEE TO REVIEW OBSERVATION GUIDELINES

As decided at the Annual General Meeting of the Canadian Avalanche Association in May, a Committee has been formed to re-examine the snow, weather and avalanche observation guidelines. Members of the Committee are Jeff Boyd, Walter Schleiss, Janice Johnson and Peter Schaerer.

Terms of reference have been established for the Committee, as follows:

> A detailed re-examination of the observations standards/guidelines will be conducted every four years by a Committee appointed by the Directors of the Canadian Avalanche Association. The Committee will consider recommendations for changes to resolve concerns arising from:
>
> - omissions
> - ambiguities
> - significant discrepancies in terms with those used by other agencies (e.g. Atmospheric Environment Service)
> - new techniques for accepted observations
> - new observations which become accepted for standard use

Those members who wish to propose changes to the guidelines are invited to forward their recommendations by January 15, 1986, to:

> Canadian Avalanche Association
> 3904 West 4th Avenue
> Vancouver, B.C.
> V6R 1P5

The Committee plans to have revised guidelines ready by the spring of 1986.

NEW DEVELOPMENTS IN AVALANCHE RESCUE TRANSCEIVERS

Technical information release by Paul Ramer
Alpine Research, Inc., 1930 Central Avenue, Suite F
Boulder, Colorado, 80301

At the International Snow Science Workshop in Aspen, October 1984, a challenge was presented to the members of the Ad Hoc Committee on Avalanche Transceiver Frequencies by Dr. Walter Good of the Swiss Federal Institute for Snow and Avalanche Research. The challenge was that if a 2275Hz avalanche transceiver could be developed that would be superior in performance, design and price to the 457kHz Autophon Barryvox, there would be an opportunity to argue for the establishment of 2275Hz as the international avalanche transceiver frequency instead of the currently planned 457kHz.

Subsequent to this meeting, Alpine Research, Inc. and Applied Technologies, Inc., both of Boulder, Colorado, jointly constructed a prototype transceiver which was tested in February 1985 in Davos by Dr. Good. Since the prototype showed promise, development work continued during the spring and summer of 1985. Production units of two new avalanche transceivers will be available by November 1985. The transceivers incorporate state-of-the-art digital design techniques and rely on CMOS logic chips for dependability and power efficiency. A description of the primary performance and operating features of these two transceivers follows.

RAMER ECHO 100

Transmit Range: 100 metres in long range transmit mode, 30 metres in energy efficient mode. Controlled by miniature switch.

Receive Range: 100 metres if buried transceiver is Echo 100 in long range mode, 30 metres if buried transceiver is Echo 100 in energy efficient mode or any other model of 2275Hz transceiver.

Receiver Output: Piezoelectric speaker, no earphones or headphones required.

Fail-safe Feature: When the receive switch is pressed, the Echo 100 will receive for 3 to 5 minutes. After this period a special tone is produced, shortly following which the device returns automatically to the transmit mode. Pressing the receive switch after the tone is heard will permit continued uninterrupted reception.

Rechargeable Battery: The Echo 100 contains a large removeable nickel-cadmium battery. The Echo 100 can be recharged by placing it into a conventional radio recharging stand, or by removing the battery and recharging the battery separately.

Battery Test Feature: An audible tone, similar to a smoke alarm, will indicate if the battery needs recharging.

COMPUTERS

Organizations that acquire new computers for avalanche work should consider equipment that is compatible with equipment of other avalanche organizations. The present users of computers are requested to submit information to Peter Schaerer about the type used. The information, to be published in the next issue of Avalanche News, will assist new users in making their choice.

AVALANCHE RESOURCE AGENCIES

It is intended to update the list of avalanche resource agencies that was distributed with AVALANCHE NEWS 17 in January 1985. The revised list will be enclosed with AVALANCHE NEWS 20 in January 1986.

All avalanche workers and agencies in Canada are requested to check the list and to send changes, additions, deletions to the offices of Peter Schaerer or Geoff Freer.

Avalanche resource agencies are those who offer services in the following fields:

1) Daily information regarding snow stability and avalanche hazards: National and Provincial Parks, highway operations, ski areas including helicopter ski operations. These organizations usually would also be equipped for search and rescue.

2) Search and rescue: avalanche dogs, emergency programs, ski patrols, mountain rescue groups.

3) Education: organizations giving avalanche courses, sources for audio-visual material.

4) Weather information.

Lists of consultants are not included.

THE AVALANCHE REVIEW

The Avalanche Review is an informal, easy to read newspaper covering all aspects of avalanche safety. It is published six times per year from November to April. Articles cover snow science, terrain, forecasting, accident case histories, safety measures, control, equipment and education. Reading The Avalanche Review is the convenient way of keeping in touch with the avalanche business and new developments in the world; anybody slightly interested in avalanche safety and control should be a subscriber.

The Avalanche Review is making a special limited offer to subscribers in Canada until December 13, 1985 - a one year subscription is available for $12.00 CAN. The regular price is $11.50 U.S. which is close to $16.00 CAN. Cheques should be mailed to:

The Avalanche Review Inc.
P.O. Box 510904
Salt Lake City, Utah 84151

OBITUARY

With deep regret, we report the death of

CHRIS SADLEIR

on June 29, 1985. Chris, 34 years old, died when a tree fell during a storm on the cabin where he stayed with his family in Hamber Provincial Park.

Chris Sadleir was a staff member of British Columbia Provincial Parks in the East Kootenay District. He had a personal interest in mountain climbing, ski touring and avalanche work which he extended to a concern for avalanche safety in the parks, particularly Mount Assiniboine Park. Chris was an active member of the Canadian Avalanche Association and conducted numerous avalanche information courses in the Cranbrook area. He was also an instructor and course leader of the BCIT/NRC avalanche courses.

His many friends will miss him and extend their sympathy to his family.

PUBLICATIONS

Effect and Frequency of Large Avalanches

Butler, David R. and Malanson, George P.

A history of high-magnitude snow avalanches, Southern Glacier National Park, Montana, U.S.A. Mountain Research and Development, Vol. 5, No. 2, 1985, pp. 175-182; Boulder, Colorado.

Martinelli, M. Jr.

"The Goat Lick bridge avalanches of 1979 and 1982". Proceedings International Snow Science workshop, October 1984, Aspen, Colorado, pp. 198-207.

Malanson, George P. and Butler, David R.

"Transverse pattern of vegetation on avalanche paths in the Northern Rocky Mountains, Montana". Great Basin Naturalist, Vol. 44, No. 3, pp. 453-458, 1984.

The authors of the first paper examine the history of avalanche activity at the southern boundary of the USA Glacier National Park. Data sources were historical records from newspapers, observations of avalanches at the railway and the highway, and tree-ring studies. The tree-ring techniques are evaluated and compared with historical records. Major avalanche winters can be expected approximately every five years.

Two major avalanche events that blocked the railway and the highway and removed a railway bridge in the study area at Glacier National Park are described in detail by M. Martinelli. The avalanches containing wet snow displayed an erratic flow pattern which was attributed to the presence of debris from previous avalanches.

In the third paper, Malanson and Butler describe the vegetation in an avalanche path. The pattern of herbs, shrubs and small trees appears to be more complex than could be accounted for by avalanche magnitude and frequency. The vegetation on one path in Montana illustrates that the topography of the path is a factor in the distribution of species. Three zones exist across avalanche paths:

a) an inner zone of herbs and suffrutescent shrubs occupying a ravine, which is snow covered longer than elsewhere;

b) flanking zones of dense shrubs and trees with flexible stems;

c) an outer zone of less dense shrubs. The pattern of vegetation seems to be more due to avalanche-related stress rather than damage.

The three papers are of interest to those who are concerned with predictions of avalanche frequency, magnitude and runout distances in relation to land-use planning and the location of utilities.

Audibility in Snow

Johnson, Jerome B.

"Audibility within and outside deposited snow". Journal of Glaciology, Vol. 31, No. 108, pp. 136-142, 1985.

Johnson, Jerome B.

"The preferential detection of sound by persons buried under snow avalanche debris as compared to persons on the overlying surface". Proceedings International Snow Science Workshop, October 1984, Aspen, Colorado, pp. 42-47.

Persons who have been buried under deposited snow either intentionally (for example, in a snow cave) or accidentally by an avalanche are well aware of the poor sound transmission properties of snow and their effect on audibility. These effects are dramatically demonstrated in the accounts of avalanche burial survivors who could hear their rescuers talking and working above them while their shouts for help went unheard.

The author identified and examined several factors which can affect audibility within and outside deposited snow. These include refraction of sound due to velocity gradients in the air above the snow, the interaction of sound waves with snow, environmental noise and the hearing process. Refraction effects outside of a snow cover were found to be insignificant. Interaction of sound waves with snow has the strongest influence on audibility. Impedance matching between a sound source or receiver and snow attenuation of acoustic signals in snow and snow layer thickness causes the large magnitude transmission losses observed for snow. Transmission losses for naturally deposited snow are less than for avalanche debris at the same density. This is due to lower air permeability values for avalanche debris. The transmission losses for nonplanar waves in vertically stratified snow vary slightly, depending on whether the wave is propagating in the direction of increasing or decreasing phase velocity. This is a small effect and not reliably detected by experiments.

Noise in the environment and the hearing process are additional factors that affect audibility and also help to explain the preferential detection of sound by an avalanche burial victim over rescuers working on the snow surface. Environmental noise, which occurs outside of the snow and not under the snow, acts to mask sound and requires that sound intensity exceed the masking level before a listener can detect it.

The author concludes that background noise - from wind, talking, mechanical equipment, walking - to which the rescuers are exposed is the principle reason for the difference in audibility between the victim and the rescuers. Additionally, a buried victim listens more intensively than the persons on the snow surface. In practice this means that a search must be carried out as quietly as possible. The searchers must stop from time to time and listen intensively for the voices of the buried persons.