CANADIAN AVALANCHE ASSOCIATION

AVALANCHE NEWS

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INFORMATION ABOUT AVALANCHE CONDITIONS IS ISSUED FROM DECEMBER TO APRIL BY THE CANADIAN AVALANCHE ASSOCIATION. BULLETINS ARE ISSUED MONDAY & THURSDAY MORNINGS ADDITIONAL UPDATES ARE MADE WHEN CONDITIONS CHANGE RAPIDLY

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The deadline for the next issue is October 15, 1994. Material may be sent to the Canadian Avalanche Centre in Revelstoke in a variety of formats. Hardcopy, Fax, ASCII, or WP5.1 are required for text. Diagrams, charts, & figures may be submitted as hardcopy, .WMF (preferred), .CGM (preferred), .WPG, .TIF, or .PIC files. Files can be sent on disk or to the PC BBS.

SNOW AND AVALANCHES 1993 - 1994

Another winter has passed by. November and December were relatively mild with below average snowfall in most regions. Heavy snowfalls in February brought most regions up to near average snowpack depths with the exception of the south Okanagan. Inside the larger regions some areas, for example, Garibaldi/Whistler and Kootenay Pass had unusually prolonged avalanche periods which were inconsistent with their usual direct action cycles.

The Rockies had the deepest snowpack in nearly ten years but the increased depth was no contributor to strength as persistent weaknesses, as usual, plagued the snowpack for the entire season. In the Interior Ranges the surface hoar, formed in early February and buried between the 5th and 9th, was the most serious contributor to subsequent slab avalanche activity that lasted well into March when warming and sporadic (but lingering) avalanche activity minimised the problem.

Avalanche incidents reported to the Canadian Avalanche Centre and described in Avalanche Involvements involved a record high number of people. For many, this was 'the winter of the close call', tragically there were six fatalities. Other large and unusual natural avalanches were reported with no involvements but which effected highways and backcountry operations. Some were triggered by the most sensitive remote additional stress and ran on slopes that had not been observed to avalanche for many years.

Each season, it appears there are these seemingly anomalous events that continue to cause fascination, curiosity and fear.

1993 - 1994 AVALANCHE SCHOOLS

This winter 228 students took the three types of courses offered. The number of students on Level 1 Ski Operations courses was up and included one course run jointly with the University College of the Caribou as part of their Adventure Travel Guide program. Students from Scotland, Iceland, New Zealand, Japan and USA attended the courses. The number of students on the Transportation and Industry course and the Level 2 was down from previous years and continues a trend of the past three years. This is partly because there appears to be less turn over in experienced staff at ski areas and fewer changes in Highways and Industry personnel. The total number of students was slightly less than the 232 of last year, the most ever.

The courses did make a modest surplus. The surplus above last years was exactly equal to the cost of Instructor Training which did not take place last but is scheduled for November this year.

At the annual spring meeting of the Instructors it was decided that course development is the most important priority. The course were originally developed by the National Research Council and British Columbia Institute of Technology in the 1970's. Recent developments in stability evaluation and teaching methods (ie interactive video) need to be introduced to courses to maintain high standards. Some changes are planned for the coming winter but funding is needed to complete the project.

No comment on the operation of the Schools would be complete without thanking Peter Schaerer for his continued committment to the courses. We are concerned when he 'retires' that he may take on more time consuming avalanche projects than this full time one he already does.

REQUEST FOR SLIDES

At the Spring Meeting it was suggested that the Canadian Avalanche Centre produce a calendar for sale as a fund raising project. Photographs are required for the calendar and may be sent to the Avalanche Centre for consideration. Suitable credit and payment will be made for any photograph used. Your imaginative and high quality submissions are eagerly awaited.

Photographs and material for course development are also required and if you have the ideal avalanche terrain photograph for route finding decisions, wind transported snow in motion or any relevant topic we can negotiate a deal. Computer generated graphics or custom artwork for overheads are also required. Please call the Centre for details.

Contributors to the Avalanche News are advised that the use of photographs with articles is encouraged.

INVITATION TO REGISTER

Qualified individuals/companies who are capable of teaching one or more of the following types of Ministry standard courses are invited to submit thier lesson plans, course outline and instructor resumes to the Ministry of Transportation and Highways for approval.

1.) One day Snow Avalanche Program - snow safety courses.

2.) Weather observations and quality control training courses

Following receipt of written Ministry approval of course content, qualified individuals/companies may proceed to schedule and advertise their courses as "Ministry appoved". Applications to attend approved courses will then be made directly by participants.

Those interested in obtaining Ministry approval for these courses may obtain the Request-for-Approval Terms of Reference by contacting:

Mike Boissonneault
Snow Avalanche Programs
Ministry of Transportation & Highways
940 Blanshard Street
Victoria, BC
V8W 3E6

phone (604) 387-7514
fax (604) 356-8143

Completed Requests-for-Approval must be received at the above address by 1400h August 30, 1994 to be considered.

Computer Based Artificial Intelligence as an aid to BC MoTH's Avalanche Forecasters

Peter Weir, P. Geo., Research Officer, Snow Avalanche Programs, MoTH, Victoria and
Dr. David McClung, P. Geo., Depts. of Geography and Civil Engineering, UBC, Vancouver

This is the second of two articles outlining advances in avalanche forecasting and snow stability evaluation techniques within the British Columbia Ministry of Transportation and Highways. The last issue described a rule based system for use in snow profile interpretation.

Statistical Avalanche Prediction System

The most advanced initiative in the field of computer based analysis in snow safety in BC is a "coupled" statistical avalanche prediction system which has been under test at Kootenay Pass. This research has been undertaken by Dr. Dave McClung of UBC over the past two winters, aided by the Ministry's most senior avalanche technician, John Tweedy from Kootenay Pass, and Peter Weir, Snow Avalanche Programs research officer, from Victoria (McClung, Tweedy & Weir, 1992).

At Kootenay Pass the Ministry's' avalanche technicians are adopting a quantitative approach to evaluation of the avalanche hazard and consequent risk assessment. A statistical avalanche prediction method is in use which couples the expertise of the Ministry's avalanche technician (the human expert) with a PC capable of high speed database searches and numerical analysis of weather data.

The human expert excels at analyzing snow stability factors which, although not readily quantifiable, are arguably more important than the simple weather variables. Stability factors include:

- snowpack structures
- slope history and results of slope tests
- snowpack temperatures and likely consequences of those temperature patterns.
- weather forecasts

These and a host of other highly relevant but hard to quantify variables are assessed by a human expert in determining an *A Priori*, or initial, probability of avalanche occurrence. (McClung & Schaerer, 1993, p125). The term *A Priori* probability is loosely defined as the expert's "degree of belief" that an avalanche may occur.

Inputs

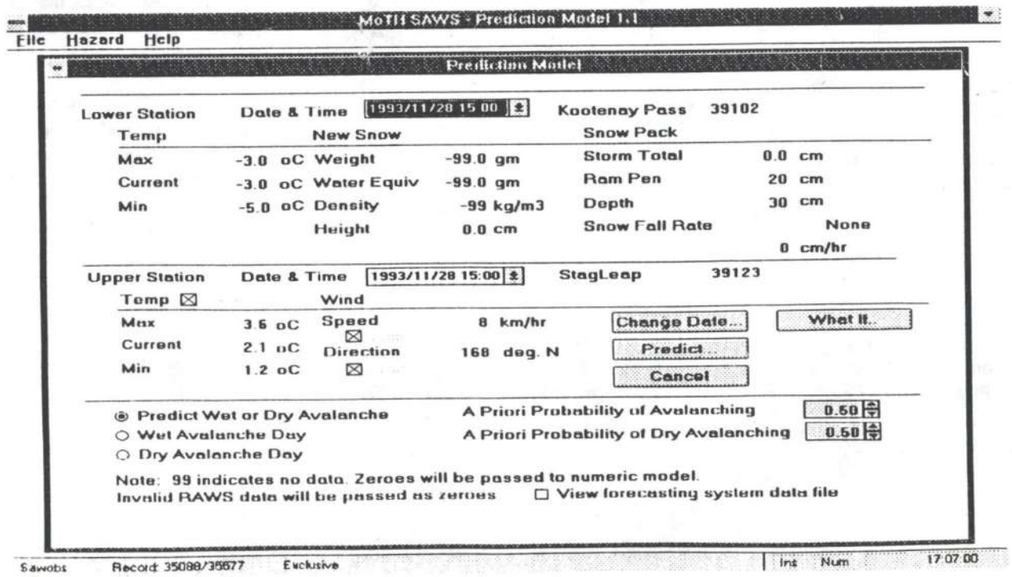
The human expert is asked to input his *A Priori* probability that

- avalanches may happen in the next 12 hours and
- whether any avalanching is likely to be dry or moist - wet.

The *A Priori* probability is expressed as a number that ranges between 0 and 1.0 where:

0.0 indicates avalanches are not possible
0.5 indicates the chances of an avalanche are about even
0.7 indicates the chances of an avalanche are somewhat likely
0.9 indicates avalanches are very likely and
1.0 indicates avalanches are believed to be certain

The Ministry's new computer system, a windows database application developed in FoxPro, has an input screen that displays the current weather as measured at two weather stations. The avalanche technician completes the two probability fields at the bottom right of the screen:



The computer, in a matter of a few seconds, undertakes two tasks. It simultaneously considers 6 or 7 weather variables (something probably few, if any, humans can do) to look for patterns that have been defined by previous statistical analysis of the Kootenay Pass database (McClung & Tweedy, 1993). It then makes a search in a 10 year database of weather records to find the 30 days most similar to the day in question. In essence the computer is used to analyze combinations of readily quantifiable weather data; a task to which it is well suited.

Outputs

The prediction model gives two outputs:

- By the application of Bayesian Statistics a *Posterior* (resultant) probability of avalanching is determined by analysis of relevant weather variables from the current observation.
- a cluster analysis gives the 30 nearest neighbors (i.e. days in a 10 year database most similar in weather to the current observations). A database tool shows the nature of avalanche activity on those days.

In the example only 7% of the 30 days most similar in weather to March 24 had avalanches. The avalanche forecaster would interpret the Magnitude and Moisture indices to determine the severity of avalanching on those neighboring days that had avalanches.

Analysis

The prediction model allows the technician to compare each of the weather variables from the current day with the neighboring days. Data have been standardized (i.e. each weather variable's mean value is subtracted from its current value and then divided by the standard deviation) which allows the technician to determine just how close each neighbor is to the day in question.

The prediction system includes a focused database search tool which allows the technician to look in detail at the avalanche activity on any of the nearest neighbors. The search shows the individual paths that avalanched on any neighboring period, the size and type of those avalanches and

- Correct prediction of avalanche days: 71%

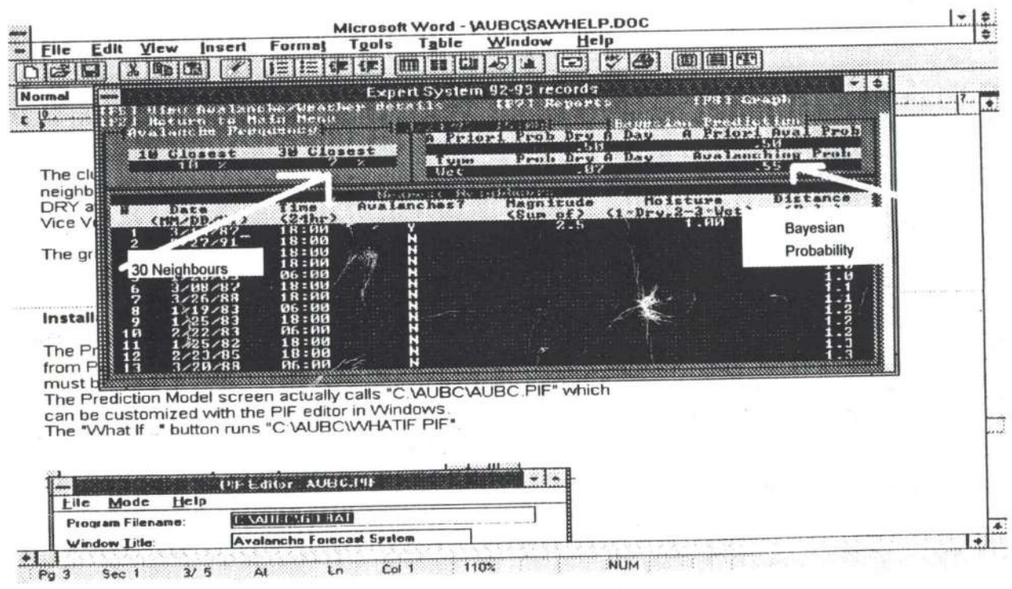
(McClung, 1994)

These values compare very well with modern weather forecasting, which these days uses large complex numerical models of the atmosphere and human expert interpretation. It is noteworthy that weather forecasts are one of the inputs that are synthesized by the human expert in production of an avalanche forecast. Similarly the inherent inaccuracy in a weather forecast will carry over into the avalanche forecast.

The analysis showed that the prediction system performs significantly better when it receives input from the avalanche forecaster than when it is run with 50:50 probability values. The system is remarkably accurate when measured in a 12 hour time frame.

Application in other avalanche areas

Given the success of this tool at Kootenay Pass, it is likely that the technique will be applied elsewhere in the Province. Bear



In the example for March 24, 1993 (this page) the output screen shows the output from the Bayesian analysis agrees closely with the human expert's prediction. The avalanche technician's *A priority* estimate was 0.50 (i.e. the forecaster considered chances of avalanching about even) and the consequent Bayesian probability was output increased only marginally to 0.55

whether they were natural or artificially triggered.

Accuracy of the Coupled Expert System

An analysis of results from the 1992/93 winter showed the accuracy of the coupled analysis system approach to be:

- Correct prediction of non avalanche days:84%

Pass in Stewart, the Coquihalla highway and the Revelstoke area are obvious candidates. However there is a considerable amount of statistical data analysis to be undertaken prior to its distribution. It is necessary to undertake a discriminate analysis of these areas' weather variables in order to determine the linear combinations of variables which will act as avalanche pre-

dictors in such markedly different climate zones.

Limitations of the numerical prediction system

Any statistical system is inherently built up within the bounds of the historical data from which it draws. The system performs well most of the time but can fail under exceptional circumstances, i.e. under rare combinations of weather variables which don't exist in the record. In this case the intuition of the human expert surpasses the system, and optimally "saves the day".

It must be noted that the numerical system makes a prediction for a 12 hour time frame. While giving a good base line the Ministry requires its staff to make decisions in the one to two hour time frame. The Ministry's experts can and do make accurate predictions within this narrow time window.

Future directions

Given the importance in weather forecast, a subsequent step in the area of computer based artificial intelligence may be to develop a rules based system for weather forecast interpretation.

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Avalanche Involvements in Canada Winter 1993-94

Torsten Geldsetzer

Over the course of the winter the Canadian Avalanche Centre collected 66 separate avalanche involvement reports. While this is a record high number of incidents reported, fatalities stayed at the lowest level of the past ten years - we had 6. Predictably, the number of incidents rose and fell with the stability.

One thing that became very obvious this past season is that we only hear about a small percentage of all the actual incidents. Our best guess is that we get less than 5% of actual incidents reported from snowmobilers, maybe 20% from individual backcountry skiers & climbers and on up to a higher percentage from ski area and heli-ski operations.

Persons Involved (at least caught, not necessarily buried)

- 68 backcountry skiers
- 32 ski area skiers
- 6 out of bounds skiers
- 8 climbers
- 9 snowmobilers
- 13 other

For a total of 136. Remember that these are only ones that got reported, in reality the numbers are higher, especially in the case of snowmobilers.

There were three episodes of poor stability which accounted for the majority of the incidents.

The first started on New Years and ran for about 10 days. This included one of the fatalities here in Canada as well as the Montana accident in which 5 snowmobilers were killed. For the areas concerned this period saw a heavy snowfall of up to 45cm which sa on a surface hoar layer which had formed a couple of days after Christmas. In addition SW winds transported this snow and built slabs of varying density which only needed a skier's or snowmobiler's weight to trigger the avalanche. The Centre put out special warnings over the radio on Dec 30, 31 and Jan 1 advising the public of these dangerous conditions, nevertheless 10 incidents were reported.

The second episode ran from Feb 10th to 16th with 14 incidents in only 1 week. This period included three of the fatalities. Again advisories over the radio were put out about poor to very poor stability. The final grouping for the season ran for most of March and accounted for at least 23 separate incidents.

Geographically, the Coast Mountains saw 16 of the 66 incidents, the Interior Mountains 23 and the Rockies had the most with 27.

Damage or loss of property due to avalanches ranged from lost ski poles to a train derailment - for an estimated total of $ 200 000.

In total we had 19 complete burials reported, and although burials accounted for 5 of the fatalities the others were more fortunate and were found by a variety of means:

Found by	Alive	Dead
Transceiver	*4 (1 - 15 min)*	*2 (35 + 50 min)*
Last seen point	3 (1 - 2 min)	
Hand to surface	*2 (1 - 4 min)*	
Dog		2 (3 + 4 hrs)
Sound (voice)	*1 (3 min)*	
Light of headlamp	1 (3 min)	
Object on surface		*1 (30 min)*
Probe	1 (10 min)	
Self rescue	*2 (<1 min)*	

1 dog was also buried but he managed to dig himself out after a couple of minutes.

There were 6 fatalities in total, 4 snowmobilers and 2 backcountry skiers.

Howard Douglas

On November 28, 1993 two ski-tourers skied into the toe of a large slope near the Sunshine ski area and triggered a size 2.5 hard slab avalanche onto themselves. Both were caught but only one was buried. The buried person was found by the other by an object on the surface and uncovered after 30 minutes of burial. He had been buried under 70cm of snow and was found face-down, he died by asphyxiation. The approximately 35cm slab slid on a melt-freeze crust which produced easy to moderate shovel tests.

Oscar Creek

On January 5, 1994 2 snowmobilers were following a logging road East of Ymir, B.C. The deceased was riding up on the upper cut slope and released a size 2.5 slide which swept him off the road and totally buried and pinned him under his sled. His partner was partially buried and tried to search but had no rescue gear - walked out 8km for help. The victim was found buried 30-50cm, 4 hours later, by RCMP dog after 5 minutes on scene. The 45cm slab ran on surface hoar and produced very easy shovel test and Rutschblock score of 2.

Middle Kootenay Pass

On February 13, 1994 eight snowmobilers were returning after recovering a snowmobile as part of a S & R near the Westcastle ski area in Alberta. All were carrying rescue gear and had been advised of poor stability and to stay off the slopes. None-the-less one went up a particularly dangerous convex slope. When a second person also went up the slope it released a size 3 avalanche which buried the first person as well as one parked at the base of the slope. The second person to go up the slope managed to ride out the side. Although everyone had rescue equipment and were wearing transceivers, they did not seem to be aware of the consequences of burial - "the shovellers did not seem overly concerned". The person that had been at the base of the slope was found after being buried for 35 minutes, under 2m of snow, cause of death was suffocation. The person that had been on the slope was found after being buried 50 minutes under 3m of snow, cause of death was trauma. The 72-97cm hard slab failed on faceting just above a 5cm melt-freeze layer from Dec 10, ran 100m and the depth of deposit was 4-6m. Note: a fatality occurred on this same slope in 1989.

Hasler Creek

On February 13, 1994 (as well!) 2 snowmobilers near Chetwynd, B.C. were riding about 500m apart when the deceased traversed into a steep chute triggering a size 2 avalanche. His partner was too far back to see it happen. The deceased was found by RCMP dog and uncovered after being buried for at least 3 hours.

Greely Creek

On February 22, 1994 a large group of backcountry skiers near Revelstoke, B.C. were caught in a size 3 avalanche. The trigger is unknown but presumed to have been either a cornice trigger or skier remote from below. Four people were partly buried and several others injured from ride through trees. One of the injuries became a fatality a week later due to complications. The 60-130cm slab initially slid on 10mm surface hoar then stepped to rounds and partially decomposed. There were several crowns, not all linked, for a total width of 500m.

Summary of Accident Involvements in Canada

Year	# of Incidents	Total Fatalities	Skiers	Climbers	Snow-mobilers	Other
1980	28	1	1			
1981	24	9	5	4		
1982	45	4	3			1 rail worker
1983	34	3	2	1		
1984	25	4			4	
1985	35	6	5		1	
1986	28	8	3		4	1 snowshoer
1987	28	7	7			
1988	34	7	6			1 PQ girl guide
1989	45	6	3	1	1	1 resident
1990	33	9	7	1		
1991	58	11	11			
1992	46	6		4	2	
1993	60	10	3	4	3	
1994	66	6	2		4	

CANADIAN AVALANCHE ASSOCIATION
Technical Meeting Report

Peter Schaerer

The Canadian Avalanche Association held a technical meeting for its members in the morning of May 4th at Penticton. The objective of the meeting, chaired by Jim Bay, was to upgrade the knowledge of the members by presenting results of current avalanche research, exchanging experiences of operations, and discussing new technologies. The directors of the Canadian Avalanche Association had prepared an interesting agenda with a variation of topics, which are summarized here for the benefit of those who missed the session.

Monitoring Snow Strength Changes

Bruce Jamieson (Department of Civil Engineering, University of Calgary) gave a progress report on the project which the University carries out in co-operation with helicopter skiing operators, Canadian Parks Service, and the B.C. Ministry of Transportation and Highways. The project was described previously in Avalanche News Number 40 (June 1993).

A principle objective of the project is to monitor the strength of weak snowpack layers with the aid of shear frame tests and to determine correlations between strength changes and properties of the snow, for example temperature, temperature gradient, density of the weak layer, and density of bed surface, load. The observations of the past two winters demonstrate that the ratio of temperature gradient and snow temperature had the best correlation, but this variable and others proved to be not quite satisfactory for making predictions about strength changes. One of the difficulties is that the snow temperature and the temperature gradient near weak layers cannot be predicted well. The conclusion was, that one must still observe the strength of weak layers directly in a snow pit.

Expert Systems

Dave McClung (Department of Geography and Department of Civil Engineering, University of British Columbia, Vancouver) described a knowledge based expert system for the interpretation of snow profiles. This work is described in Avalanche News Number 42 (see also the article in this issue). The British Columbia Ministry of Transportation and Highways initiated and funded the project in co-operation with other funding agencies.

The system which is evolving continuously will be field-tested in several avalanche safety operations in the coming winter. Eventually, the expert system will serve as a backup to experienced avalanche hazard forecasters, and, if successful, extend to the interpretation of weather factors.

Study of Snow Distribution

Doug Kelly (University of Victoria) presented results of his study about the correlation of the accumulation of snow in avalanche starting zones and wind. On snow boards, that were placed in avalanche starting zones in the Coquihalla Pass, he measured the water equivalent of the deposited snow and determined a load ratio. The load ratio was defined as the ratio of the water equivalent of snow at the observation site to the water equivalent of snow observed over an equal period of time at the weather station. The load ratio for given slopes was correlated with the wind direction, wind speed, temperature, and humidity.

Doug Kelly observed maximum load ratios of 2.9 and, as expected, sites with a greater loading wind (lee side) had greater load ratios. It proved impossible, however, to make useful accurate predictions of the load ratio at given slopes from observations at the weather station.

Application of Hand Charges

Chris Stethem (Chris Stethem & Associates, Canmore) informed the members about the regulations with respect to the pre-priming of hand charges in avalanche control. The results of the sensitivity tests of pre-primed charges in 1993 were reported in Avalanche News Number 41 (Fall 1993). In the meantime, ICI explosives company supported the results and conclusions of the Canadian Avalanche Association and, because of the greater margin of safety, they recommended pre-priming with certain restrictions (only for hand charges and helicopter bombs, 1 m fuse length, pull wire igniter to be attached only at the shot point). However, because the Workers Compensation Board of British Columbia has not changed its regulations as yet, avalanche safety operations must still obtain individual variances by submitting their procedures for approval.

Liability Insurance and Waivers

Doug Banert (Marsh & McLennan Ltd. Insurance Brokers) drew attention to the state of liability insurance. In this past year, insurance companies have again suffered great losses, for example as a result of the Los Angeles earthquake, the extreme cold weather in Eastern Canada and U.S.A., and high liability claims. As a consequence, the rates of all types of insurance, including liability, homes, motor vehicles, and ski operations tend to climb, and clients may not even be able to obtain insurance unless the underwriter is satisfied about the proper management of risks. The message for operations is, to engage in a good program of risk control.

Waivers are a means for protecting ski operations against some liability. Doug Banert recommends that every operator should use waivers (it may not necessarily be signed by the client but could be displayed only) and to contact the insurance agent in good time prior to the renewal of insurance.

Robert Kennedy (Alexander Holburn Beaudin & Lang, Vancouver) a lawyer who works with the ski industry, explained that waivers are useful and often allow a quick settlement of claims. Over the past years, the ski industry has developed a good program of informing the ticket and season pass holders about risks and training its staff on how to deal with questions of waivers. The program has prevented many challenges of waivers and five cases were dismissed in applications to courts. As a result, the willingness to sue ski areas has decreased.

Robert Kennedy recommends that the clients of recreation operators (for example heli-skiing) are made available a copy of the waiver ahead of time (for example with the brochure) then sign the waiver at the start of the activity with a member of the recreation company as a witness. He mentioned also, that waivers signed by minors (persons under age of 19 in British Columbia and under 18 in Alberta) are not enforceable, even when they are co-signed by parents.

Recently, the Law Reform Commission of British Columbia, with a mandate from the Attorney General to study liability questions in recreation, has recommended that waivers be curtailed in back country operations. This may be a regrettable development, but the final decision has not been made as yet.

Avalanche Control at Kootenay Pass

John Tweedy (B.C. Ministry of Transportation and Highways, Kootenay Pass) informed members about current modifications to the avalanche control for Highway 3 at Kootenay Pass. The avalanche safety program, initiated in 1975, previously relied on avalaunchers and road closures, supplemented by benches with snow catching dikes, helicopter bombing, and hand charges. In 1992/1993 the Ministry made an economic impact study of the closures and the avalanche control resulting in the following changes:

- In 1993, avalaunchers were replaced by 105-mm recoilless rifles including new towers at three gun positions.
- The benches were enhanced and earth mounds were built at one avalanche path.
- In 1994 a gazex will be installed near the tramway to the microwave station.

The recoilless rifles proved to be a success in the winter of 1993-1994. Because of the greater accuracy of rifle shooting the avalanches were released with a greater reliability, therefore were smaller, the length of road closure was reduced, helicopter bombing was cut down, and the avalanche control crew was under less stress. The drawback was unexploded shells which had to be destroyed in the summer and a possibility of shooting over the mountains into backcountry skiing terrain. Several used avalaunchers are now for sale through the British Columbia government; information about them may be obtained from John Tweedy. See the advertisement in this issue.

Gazex at Duffey Lake

Scott Aitken (British Columbia Ministry of Transportation and Highways, Pemberton) and Karl Ernst (Mueller Lifts, Vernon) reported on the installation and experience with the Gazex at the avalanche path No. 51.0 at Highway 99, Duffey Lake. The equipment was described in Avalanche News Number 41 (Fall 1993). In past years, the avalanche path produced frequent avalanches on the road even late in the spring. The terrain and weather did not allow control by artillery or helicopter bombing. The control by gazex was a success in the past two winters. Unexpected avalanches were rare, and the amount of snow on the highway was reduced. The cost of the equipment and installation was high ($330 000), but less than the best alternative, which was a snow shed. The operational cost was close to $200 per explosion.

Ski Operations

Robin Siggers (Fernie Ski Valley) described the avalanche control program at the Fernie ski area. The principal problem is avalanches from starting zones above the developed ski runs. The 1993-1994 winter was generally warm and had three major avalanche cycles.

Ken France (Kootenay Heliskiing, Nakusp) discussed the winter of 1993-1994 in the interior of British Columbia. On the average, the weather and snowpack were normal, but there were strong variations of temperatures and snowfalls. The snow stability ratings were generally higher than in other winters. In the Nakusp area surface hoar is a consistent concern in helicopter skiing; it produced a few surprise avalanches.

Robert Whelan (Nelson) presented a list of backcountry ski lodges and huts and snowcat operators. There are 16 in British Columbia and 8 in the Rocky Mountains. Rob recommended that operators initiate an exchange of avalanche information.

Mountain Weather Forecast

Vello Puss, Ralph Janes and Ken Little (Atmospheric Environment Services, Vancouver and Kelowna) informed and answered questions about the mountain weather forecast. [Ed note: Please see AES article in this issue] They pointed out, that the basic forecast is still presented free of charge but the AES must recover the cost for additional services. Avalanche safety operations will find it most economical to obtain the daily weather information through the Canadian Avalanche Centre rather than paying for a special delivery service.

The mountain weather forecast contains predictions of the amount of snowfall under the categories: nil, light, moderate, heavy. A verification of the snowfall forecasts in the winter 1993-1994 demonstrated the following accuracy:

- Correct within a category: 50-60% of forecasts
- Out by one category: 35 - 40 % of forecasts
- Out by two categories: 4 - 8 % of forecasts

There was a tendency to forecast more snowfall than was actually observed.

It was commented from the floor that the weather offices do not use enough information from the mountain weather stations, mainly those of helicopter ski operations. There appears to be a lack of communication between the operators in mountains and the weather office.

American Association of Avalanche Professionals (AAAP)

Stuart Thompson brought greetings from the sister association in the United States. He reported that the AAAP is active, growing, and financially stable. It approved a code of ethics and now deals with problems of standards. A strategic planning committee is working to define the future of the Association.

CANADIAN AVALANCHE ASSOCIATION
Public Meeting Report

Jim Bay

The second Annual Public Meeting of the Canadian Avalanche Association was held in conjunction with the Annual General Meeting in Penticton, B.C.. The meeting was called to order at 0830. Attendance was approximately 80 people. The trade show was again a popular addition to the proceedings with good representation from the various commercial groups dealing in avalanche safety, search and rescue, and computer software products

The following is a summary of the presentations.

The meeting was opened at 0830 May 5, 1994 by the president, Bruce Jamieson. The participants were welcomed to Penticton by the acting Mayor Mr. Mick Kelly, who encouraged everyone to take part in the many activities Penticton has to offer.

Public Safety Services of the Canadian Avalanche Centre
Alan Dennis - Manager of the Canadian Avalanche Centre summarized the history of the Centre services and how the initial funding was obtained. The Centre has just completed its third season of winter operations. Alan emphasized that the Avalanche Training Schools and the Industry Information Exchange are integral to the success of the Public Avalanche Bulletin. These two activities produce the consistency in standard with which the information is gathered as well as the vehicle for providing a substantial amount of quality data which is used for assembly of the Bulletin.

The Training Schools had another successful season, with a slight increase in enrolment over last year. The number of participants in the Level 1 Ski Operations courses rose sharply while the other courses dropped slightly.

The number of backcountry fatalities has remained roughly the same per winter over the past many years even though the number of backcountry users has increased dramatically. This may be in no small way related to the presence of the Canadian Avalanche Association Training School program and we should feel proud that perhaps we are making a difference.

The Industry Information Exchange (INFOEX) and the Training Schools are presently financially self-sufficient.

Last winter the Public Bulletin received approximately 25,000 calls. A significant number of callers could not get through because the lines were often busy. This problem will hopefully be solved in the coming year by the addition of 'local' numbers for callers in the Vancouver and Calgary areas. These two centres presently account for about 50% of total calls.

The funding for the Public Services of the Centre has increased dramatically over the past three years from $3,200 in the first year to $30,500 last year. The cost of operating these services is presently approximately $58,000. Alan encouraged everyone to push for more funding wherever possible to help balance the books.

Skier triggering of soft slabs
Bruce Jamieson reported on a research project that he is working on with Colin Johnston through the University of Calgary Dept. of Civil Engineering. This project is funded by the Natural Sciences and Engineering Council and the ski industry.

Studies of avalanche accidents show that 93% of the avalanches were triggered by the people involved. Surface hoar was the critical layer in 28% of accidents, while new snow instabilities was a factor in 6% of accidents.

The study area for this project includes the Rocky and Interior Mtns. in Alberta and B.C.. The project looks at skier induced stress on slabs and is based on an original study done in Switzerland. The Swiss study did not include ski penetration as one of the contributory factors in calculating the stability index. By including ski penetration as well as the stress due to the skier, the U. of C. study found that the relationship between the stability index and skier triggers was improved.

The study appears to show a strong relationship between the stability index and skier triggered avalanches.

B.C. Snowmobile Federation
Dan Pecora - Safety Director for the B.C.S.F. described the activities in education of Federation members in backcountry and avalanche safety. He stressed the need for cooperation of all groups such as the Canadian Avalanche Association, snowmobile manufacturers, and snowmobile clubs.

There are approximately 10,000,000 snowmobilers in North America.

Dan reported that there is a steadily increasing use of avalanche safety equipment, and avalanche awareness among snowmobilers. He is encouraged by this trend and expects that it will continue.

New sources of avalanche control artillery
Doug Kelly has recently explored various international sources of artillery with practical applications for avalanche control.

He feels the most promising find so far is from Russia and is called the SPG-9 recoilless anti-tank gun.

The gun is a smooth bore weapon, firing fin-stabilized rounds at approximately 700 m/s. The effective range is about 4800 metres. The projectile weighs 5.4 kg with a 1.45 kg explosive charge. The gun weighs 59 kg and is designed to be vehicle mounted. The cost landed in Canada is estimated to be $70,000 for the gun and $250 per round.

This gun is currently in production (not surplus) so the supply should be reliable.

With the presently diminishing supply of 105mm rifles and ammunition this may be a viable alternative for consideration. Doug is continuing to pursue more information on this and other potential alternative avalanche control devices.

AES mountain weather service update
Al Wallace reported on the happenings at the new Kelowna weather office.

The Kelowna office is now fully staffed and up and running.

Public safety weather products are provided at no charge to the Canadian Avalanche Centre. The AES staff assisted in setting up the communication link between themselves and the Avalanche Centre.

The AES is proposing to develop an Avalanche Weather Training course which would be a joint venture between AES, Parks Canada, and the CAA. They are presently pursuing government funding for the project.

As part of their new 'cost recovery' mandate, the AES is now taking on commercial advertisers to help pay for their services.

Some of the products they now offer are:
- Avalanche Centre bulletins
- Weather Board - BBS with various products for $.
- BBS with satellite info and imagery ($)
- Fax based delivery service ($)
- Specialised forecasts at cost
- Consulting services - direct communications with forecasters.

Al encouraged anyone in the area to visit the Weather Centre and see for themselves, this new facility.

Avalanche incidents in Banff 93/94
Marc Ledwidge summarized the incidents in Banff over the past winter. Banff Park has the highest accident rate in Western Canada, with the majority of incidents being 'close calls'. This year there were 17 incidents resulting in 1 fatality and 2 individuals sustaining serious injuries. Poor safety measures and routefinding errors were the most common cause of incidents.

New Park residents are a major factor in these involvements. Parks is attempting to provide more public awareness to these new residents.

Weather modification group - Projectile developments
Reg Sellers of the Weather Modification Group, based in Okotoks Alberta, presented his groups work on development of self-propelled explosive projectiles. They feel that with further development work, these projectiles may have a future in avalanche control work. The current version which is a small fin-stabilized rocket carries a 200 gram explosive charge and has an estimated velocity of 300 m/s. Reg showed a video of some test firing which was interesting but revealed some accuracy problems with the projectiles. Reg and his group will continue making refinements and hope to develop a product that the avalanche community will find useful.

Mountain watch project
Chris Stethem described an interesting project he has recently been working on. A new product is being developed which will simultaneously monitor several aspects of snowpack behaviour. This device is a sturdy, flexible, articulated pole containing various sensors. Placed in avalanche starting zones and incorporating such sensors as tilt meters, temperature, and acoustic probes, this product can monitor acoustic emissions, movement, and temperatures within the snowpack.

This product was extensively tested in the Lake Louise area last winter and shows great promise as a predictive tool for estimating slope stability and as an alarm device for registering avalanche events.

Canadian Avalanche Rescue Dog Association
Anton Horvath summarized the activities of CARDA in the last year.

There are presently 38 Active and 18 Associate members in their Association. There are 14 teams currently validated and an additional 20 in training.

CARDA has updated and revised their training and certification standards. The CAA Level 1 avalanche course is now a requirement for dog handlers. The ACMG has taken on the role of evaluating the alpine skills of dog handlers. CARDA members are getting more involved in the training of handlers and relying less on the R.C.M.P. This year there were two dog courses held. The courses are one week in duration and cost $450.

CARDA had one official callout this year in the Garibaldi area. Response time is critical and the dog handlers would like to be called sooner whenever possible.

The present trend seems to be for the local R.C.M.P. to turn over the Search and Rescue activities to the private sector.

Rescue equipment
Mike Mortimer of the Hostel Shop in Calgary, reported that at the latest trade show in Germany the new transceiver development is a three light system which is supposed to improve ease of searching. He finds that he is now selling almost exclusively '457' beacons.

This past winter a problem was identified with the Ortovox F1 and F1 plus beacons. Apparently it is possible to turn the beacon from transmit to receive with a brushing motion across the face of the unit. This problem is being addressed by Ortovox.

Accidents
Torsten Geldsetzer gave a summary of the incidents of '93/94. The number of people involved this season was 136. See the accompanying chart in this Avalanche News.

Brian Cusak of Westcastle ski area described an avalanche incident he attended near Pincher Creek which resulted in two fatalities. Stan Bones of the Forest Service in Montana reviewed the incident in his area where four Canadians were killed. Both of these incidents involved snowmobilers and revealed a lack of avalanche awareness and safety equipment.

The last item on the agenda was a raffle where some highly desirable prizes were awarded. Thanks to the sponsors whose donations made the raffle worth waiting for.

The Public meeting was adjourned at 1430.

SARSCENE '94

A Canadian Search and Rescue Conference sponsored by the National Search and Rescue Secretariat will be held at the International Plaza Hotel and Conference Centre, 655 Dixon Road, Toronto, Ont. from October 13 to 15, 1994

The themes will cover:
- Critical Incident Stress Managment
- Lost Person Behaviour
- Liability in SAR
- Standards
- Ground Search and Rescue and SAR Volunteers

There is no charge for attendance, however registration is required. Please mail or fax the form, or call the Secretariat to register.

Hotel accomodation is available at a special conference rate at the International Plaza. Individuals must make their own hotel reservations. **Contact the Plaza at 1-800-668-3656, or fax (416) 244-9584** and refer to SARCENE '94. Mail to:

The National Search & Rescue Secretariat
275 Slater Street
Ottawa, Ontario K1A 0K2
Tel: (613) 996-3733
Fax: (613) 996-3746

INDUSTRY INFORMATION EXCHANGE

Torsten Geldsetzer

The 1993-94 season went pretty smoothly. We appreciate all the feedback we received from our questionnaire. Although we tried a few changes near the end of the season the format looks much the same as always. We continue to hold the confidentiality of the exchange in high regard and will, in fact, take further measures to ensure it continues next season. We are still promoting the computerized issue and hope more of you will join us in modem land. A few changes in terms of cost will be coming up next season, I think you will like them. For those of you not yet part of the exchange I would like you to consider joining next season - I think you will find it beneficial to your organization.

We made a couple of steps forward in terms of standardizing the data reported, thanks in part to a good reception of the glossary and abbreviations sheet we distributed in early January. While there are still quite a few areas where we can improve, it seems like most of us are speaking the same language. Data standards are an evolving subject that should improve with the work being done by the data standards committee. Look for preliminary results by the beginning of next season and a completed new set of guidelines by April 1995.

As the data standards become more computer friendly we will be pushing more and more for you to use modems instead of faxing. Input received by modem can be transferred directly into the InfoEx report which means less typing. Less typing means less time to prepare the report which means cheaper production costs and a lower cost for the InfoEx.

Right now we anticipate the costs for next year to go down to $ 800.00 for modem users and it will stay at $ 900.00 for fax users. In future years the costs could drop even lower depending largely on the number of subscribers - so tell your friends.

For next season we will be offering the InfoEx on a per week basis for special cases, with a probable cost of $ 100.00 per week. This type of subscription will be limited to discontinuous operations and they will need to go through an approval process.

One issue that became contentious this past season is that of data input. An important aspect of the InfoEx is that we receive regular input from our subscribers - that is part of the agreement. Most operations were quite good in this regard, but a few did not live up to their end of the bargain. I know some subscribers have manpower or communications problems but I think everyone would appreciate it if they put more effort into relaying data to us more regularly next season.

Further to the input issue is also that of timeliness of data. Some operations report in the morning and since the InfoEx is published in the evening their data is dated by the next morning. Up to date information about avalanche occurrences is particularly important. We hope these operations will recognize this and accommodate the rest of the subscribers next season.

We look forward to seeing all of our present subscribers again next season and hope that others will join in this mutually beneficial exchange. The future looks good - we are working to make the exchange more real-time, more standardized, more extensive, and more cost effective.

There were 44 subscribers this past season.

1993/94 Industry Information Exchange Subscribers

Banff National Park
BC Highways Bear Pass
BC Highways Central Region
BC Highways Coquihalla
BC Highways Duffy Lake
BC Highways Hope
BC Highways Kootenay Pass
BC Highways Kootenay Region
BC Highways NW Region
BC Highways Revelstoke
Blackcomb Ski Area
CMH Adamants
CMH Bobbie Burns
CMH Bugaboos
CMH Cariboos
CMH Galena
CMH Gothics
CMH Monashees
CMH Revelstoke
CMH Valemount
CN Skeena
FerNie Snow Valley
Glacier National Park
Great Canadian
Island Lake Lodge
Jasper National Park
Kananaskis Country
Kootenay Heliskiing
Kootenay National Park
Marmot Basin Ski Area
Mike Wiegele Heliskiing
Mount Washington Area
Mountain Heliskiing
Norquay and Mystic Ridge Ski Area
Purcell Heliskiing
R.K. Heliskiing
Selkirk Tangiers Heliskiing
Selkirk Wilderness
Silver Star Ski Area
Tyax Heliskiing
Waterton National Park
Whistler Mountain Ski Area
Whitewater Ski Area
Yoho National Park

WEATHER PRODUCTS

Torsten Geldsetzer

This past season saw the first distribution of a custom weather forecast through the Avalanche Centre. For next season we are investigating additional products, such as weather maps, and potential other sources for these products - Environment Canada is not alone out there. [see accompanying article from AES] The Avalanche Centre has become a convenient and cost effective distribution centre for a number of different weather products. We are doing this primarily to benefit our InfoEx subscribers but others are also welcome.

In addition to the custom forecast our regular weather products service also includes Fidelity data, Highways remote weather station data, and CMH Lodge weather observations. Distribution of these products is by computer bulletin board as well as automated, customized faxing. Let us know what you need.

We would like to include the Rockies region in next seasons forecast. However, it looks like we would need at least eight subscribers in that region to make it financially viable.

We have not yet finalized our prices for next season, but they should fall between $65 and $90 per month - even at the high end this is much less than what you would pay individually - we can buy in bulk and pass on the savings.

1993/94 Weather Products Subscribers

CMH (10 Lodges)
Elkview Coal
Evans Malakwa
Golden Alpine Holidays
Great Canadian Heliskiing
Island Lake Lodge
Kootenay Heliskiing
Mountain Heliskiing
Purcell Heliskiing
R.K. Heliskiing
Robson Heliskiing
Selkirk Tangiers Heliskiing
Whitewater Ski Area

EDITORIAL NOTE

The intention of *AVALANCHE NEWS* is to assist communication among persons and organizations engaged in snow avalanche work in Canada. Short articles cover accidents, upcoming and past events, new techniques and equipment, publications, personal news, activities of organizations concerned with avalanche safety, education and research.

The editor welcomes and expects contributions; all reasonable comments and discussions will be printed. The articles in *AVALANCHE NEWS* reflect the views of the authors; only when it is specifically stated do they represent the opinion of the Canadian Avalanche Association.

No paid advertisements are carried. Suppliers who wish to draw attention to their products should send information to the editor who will publish a note when equipment has value in avalanche work and safety.

***AVALANCHE NEWS* is published three times per year. There is no subscription fee. Requests for copies and changes of address should be sent to the publisher.**

THE MOUNTAIN WEATHER SERVICES OFFICE: New Horizons

Ken Little

A year ago in June, Environment Canada officially opened the new Mountain Weather Services Office (MWSO) in Kelowna. The MWSO is perhaps the most visible component of a major restructuring occurring within Environment Canada's operations; but the physical building is not nearly as important as the concepts it houses. The MWSO is a scientific entity, dedicated to continuous learning. As such, it will benefit from its close proximity to Okanagan University College. The MWSO is a client-centred facility, fully responsive to its customers needs. The MWSO represents Environment Canada's new way of doing business, and reflects the corporate vision statement : "People providing quality service through science."

One of the goals of the MWSO is to provide enhanced weather services to the BC Interior; while at the same time remaining fiscally responsible to the Canadian taxpayer. We are achieving our goal through the efficient use of technology and people. This means retraining our existing staff to handle more complex tasks; while at the same time employing advances in automation to eliminate repetitive tasks and broaden service. Consultation with consumers of weather information has consistently highlighted the desire for more detailed forecasts and more access to weather information. Access has been improved through intelligent use of automation. Interactive phone information systems and automatic telephone answering machines tied to a Weatheradio network have allowed the MWSO to provide round-the-clock weather information to more Interior communities than ever before. At the same time, forecast detail has been significantly enhanced. Gaps in the existing data networks have been identified and are being filled as resources allow. Advances in communications and workstation technologies have allowed us to implement new tools for receiving and processing data in "real-time". A regular program of internal training ensures that new technologies are fully utilized. From a customer perspective, the end result is a forecast which is "tuned" to individual districts or to defined industry needs.

Let's examine how this whole process works in the case of one industry's requirements. The snow avalanche control community in British Columbia is a group of professionals who share a common need for timely and accurate weather information. There's a lot of similarity between the job of a meteorologist and that of an avalanche forecaster. Both require access to a continuous stream of data in order to make informed decisions. The meteorologist's primary job is to diagnose, analyze, and forecast the weather, but weather is only one of the factors which an avalanche forecaster must consider. Time is the big constraint. Time to wade through all the data. Time to mobilize resources. Time to think.

What the avalanche forecaster would appear to need is a custom weather report, delivered just-in-time to wherever the action is. To a large extent, that's exactly
what is already available through the MWSO and the Canadian Avalanche Centre (CAC). Subscribers to the CAC's Information Exchange and Bulletin Board will be quite familiar with the product. Anyone with a PC or a fax machine can (for a monthly subscription fee) have access to a custom bulletin which brings together current and forecast weather information into one easy-to-read compact package. The bulletin is produced every morning during the winter season by senior MWSO staff, and stored on a PC bulletin board system (BBS) for uploading to the CAC's BBS. The CAC BBS then makes the bulletin available to subscribers via either direct-dial PC access or faxback service.

None of this is free, of course. The MWSO bills the CAC for its services as part of a commercial agreement between the two offices. Services are competitively priced to the market they serve. Last season is a good example. Regular users of the CAC bulletin board were able to access the weather bulletin for just over $2/day. Compare that to the cost of subscribing to a commercial bulletin board, and having to slog through piles of menus and raw data to get the information you. The MWSO-CAC arrangement is mutually beneficial to both parties. Users of the CAC BBS have access to a single source for both weather and avalanche information, at a significant discount to the cost which they would incur if setting up an individual account for weather support from Environment Canada. This "one-stop shopping" concept benefits the MWSO since workload schedules can be anticipated well in advance. Improvements and upgrades to the basic product are ongoing, based on user feedback and available resources. This is but one example of a successful partnership between government and industry. The CAC bulletin was developed through ongoing consultation and feedback, and meets the dual objective of providing enhanced weather services while limiting expense to taxpayers through cost-recovery.

To date, the CAC weather bulletin remains strictly text; but this can easily include graphics (charts, satellite imagery) if and when enough customers demand more.

Some customers do demand more than the basic weather information, and Environment Canada can meet those demands. A variety of on-line and fax-based services are either in place now or under development, and your local Environment Canada office can provide up-to-date information.

As of June/94, the following services were available through the Commercial Services Division of Environment Canada's Pacific Weather Centre in Vancouver.

WEATHERBOARD:
PC BBS providing on-line access to text and graphics including satellite imagery.

AUTOCOMM:
Automatic scheduled delivery of text products via fax or personal computer.

AUTOSERVE:
Interactive (touch-tone) "faxback"/mail service

PROSERVE:
Custom services and satellite imagery for PC delivery (similar services will be available from the Kelowna MWSO this fall)

Let's not forget Weatheradio. This (free!) service broadcasts weather information around the clock, on either VHF or low-power AM/FM band. Contact your local Environment Canada office for the location and frequency of the Weatheradio transmitter nearest you.

Full-service forecast production and distribution facilities are located in the BC Interior at Kelowna (MWSO) and on the BC Coast at Vancouver (Pacific Weather Centre).

Branch offices of Environment Canada are located throughout BC (Kamloops, Castlegar, Revelstoke, Prince George, Victoria, Port Alberni, Port Hardy and Terrace) Check the blue pages of your phone book under "Government of Canada," "Environment Canada" or "Weather Information" for the office nearest you.

(the author is a supervising meteorologist and program manager at Environment Canada's Kelowna office, ed.)

[Ed note - the following list of weather resources is reprinted thanks to the Avalanche Review and Dan Judd]

The Weather Network
phone (514) 597-1700

The Weather Channel
phone (310) 785-0500

NOAA Weather Radio
National Weather Service (USA)
Attention; W 112
Silver Spring, MD, USA 20910

Zfx
Alden Electronics
40 Washington Street
Westborough , MA, USA, 01581 - 0500
fax (508) 836-3711

World Weather Watch
401 Bentley Street - Unit 4
Markham, ON, L3R 9T2
phone (416) 477-4120
fax (416) 477-0824

Weather Brief
(801) 530-3131

PC Weatherman
(717) 822-3236

Accu-Weather Inc
(814) 237-0309

APPOINTMENT

We are pleased to announce that the President of the University of British Columbia, Dr. David Strangway, has recommended that Dave McClung be promoted to full Professor in the Departments of Geography and Civil Engineering. Congratulations Dave!

OBITUARY

On April 17 1994, Dr. Robert F. Legget died in Ottawa shortly before his 90th birthday. Dr. Legget initiated and promoted avalanche research and control in Canada and thanks to his support the avalanche studies have received a good start and have reached a high standard.

In 1945, Dr. Legget visited the Snow and Avalanche Research Institute at Davos in Switzerland in connection with a study of geotechnical research on behalf of the Government of Canada. He was impressed by the work of the institute and decided that this was what Canada, having more snow than Switzerland, should have as well. Two years later, Dr.Legget was appointed Director of the new Division of Building Research of the National Research Council of Canada. In developing the Division he formed a Snow and Ice Section which had the task of studying problems of snow as well as ice on lakes and rivers in Canada. When the Canada Department of Public Works requested assistance with the avalanche control at Rogers Pass in 1956, Dr. Legget made available the instrumentation and staff for the project. In this way he generated the avalanche studies of the National Research Council. He continued a strong interest in avalanche work, visiting Rogers Pass several times, and supported the later avalanche studies. He also encouraged co-operation when ski areas, highways, and other operations requested assistance with snow and avalanche problems. It was through the good offices of Dr. Legget that the 1954 International Classification of Snow and later the Guidelines for Weather, Snowpack and Avalanche Observations were published.

Peter Schaerer

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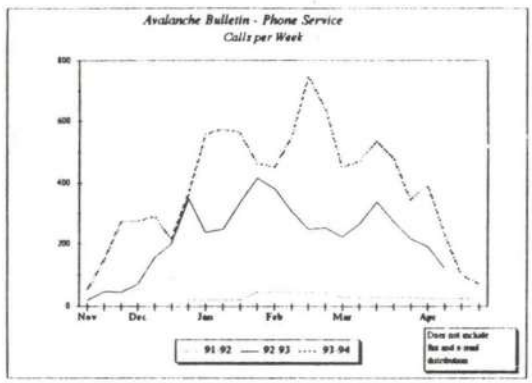
SEARCH AND RESCUE / RECHERCHE ET SAUVETAGE

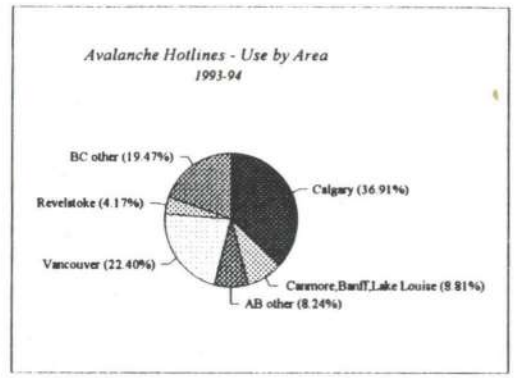
AVALANCHE BULLETIN

The Avalanche Bulletin is now being used by over 25,000 people. This is the total from distribution by 800 number calls, fax network, calls to Vancouver & Calgary local numbers and through the PC Bulletin Board. Both graphs shown below are based on data produced by use of the 800 toll free number.

The periods of high use of the Bulletin are in direct relation to avalanche cycles. The split on use between Alberta and British Columbia is close to equal with more avalanche forecast products (Rocky Mountain National Parks & Kananaskis) being available to those in Alberta.

The Avalanche Bulletin cannot succeed without the continued support of the good sponsors whose names and logos are shown in this issue.





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YAMAHA

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The Weather Network

BOMBARDIER ski-doo