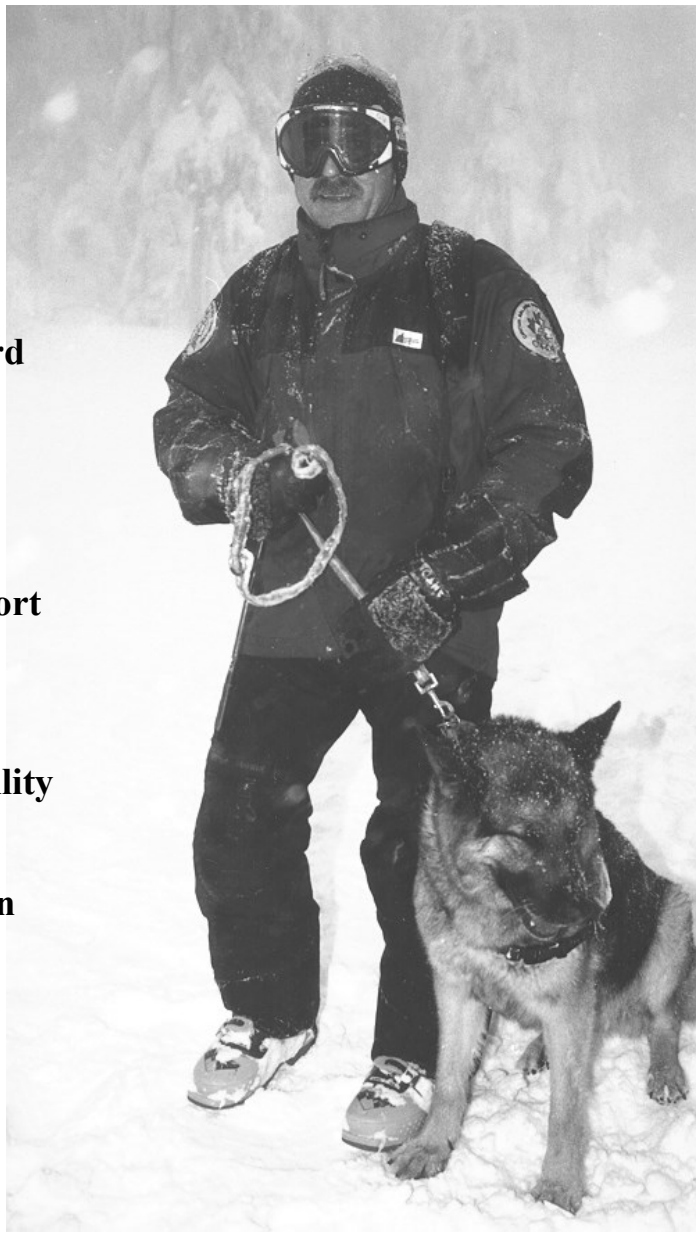
AVALANCHE NEWS

FALL 2000 **Volume 60**



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CANADIAN AVALANCHE ASSOCIATION

AVALANCHE NEWS

CANADIAN AVALANCHE ASSOCIATION

DINY'S NOTE

August 2, 2000

To: Canadian Avalanche Association Board of Directors;
Members of the Canadian Avalanche Association

From: Diny Harrison

Re: **Resignation as President of the Canadian Avalanche Association**

With the selection of my husband Clair Israelson as the new Managing Director of the CAA/CAC, to avoid conflict of interest I am resigning as President of the Canadian Avalanche Association, effective immediately.

I thank you for the opportunity and privilege of serving on the Board of Directors for the past three years, and for your confidence in electing me as your President at the Annual General Meeting in Penticton last spring. I regret that I will not be able to complete many things I had hoped to accomplish on your behalf while President, but feel fully confident that the interests of the CAA will be handled well under the capable leadership of our new President, Bill Mark. I believe these changes are all for the best, and look forward to a new and exciting era for the Canadian Avalanche Association and the Canadian Avalanche Centre.

For the future, I remain committed to serving the CAA in whatever capacities the Board and membership find appropriate. I urge everyone to offer their best wishes and support to both Bill and Clair in their new positions, and to continue our tradition of working together to further the goals and initiatives of our Association.

Sincerely,

Diny

PRESIDENT'S MESSAGE

I would like to take the opportunity to thank the rest of the CAA Board of Directors for their support of me as the new President in the last few months. It is an honour to serve the members of this organization.

The Board has been working hard over the last few months to help better define the way the CAA operates. As we continue to grow we need to develop more consistent policies, procedures, and guidelines for supporting you, the members of the CAA as well as providing services for other organizations in the avalanche industry. Thank you everyone, on the Board, on the committees and to all members who have given input and ideas so far.

I would also like to welcome Clair Israelson to his the position of Managing Director. With Clair's proven past experience in both the avalanche field as plus his as administration, he has already proven to be an asset to the Organization.

Have a safe and enjoyable winter

Bill Mark
President

Visit us at our website...

www.avalanche.ca

NOTE FROM THE NEW GUY AT THE CAC.

Wow. What a surprise to find myself as the Managing Director here at the Canadian Avalanche Centre. The trails of life take us to such interesting and surprising places! The adventure continues.

My decision to get involved in this capacity was driven by three important factors. First was the realization that our members are simply the best group of people I have ever known. The history and core values of our Association, roughly put as "Work together, and do the right thing" were the second factor that drew me here. And third but not last was the encouragement from my wife Diny, who, to avoid conflict of interest, resigned as the CAA President when I accepted this job. Diny worked extremely hard during her short time as our President, and I know she would have continued to represent our Association well.

I look forward to learning the many things I'll need to know in order to meet your expectations for this position that you have trusted me with. I'll do my best to fulfill those expectations. The entire Board of Directors and all of the Centre staff have been a great help over the past two months. I thank them for their patience with me as I get up to speed. I'll need your help and patience, too.

I'm excited and a bit awed by the challenges we face as we move forward. In recent years there have been a few growing pains caused by the rapid growth of our Association's activities. However, as I come to better understand these issues, I'm heartened to discover that in every case it is good people, all trying their best to do the right thing. And the more that an issue is debated, the more it proves that all of these good people really care that the outcome is the right one. As Managing Director my goal is to work closely with our Board of Directors, CAC staff, our membership and our clients to help resolve these few aches and pains, and position our Association for healthy growth toward the vision we shared at our Annual General Meeting in Penticton last May.

Over the winter I plan to visit as many of you as I can, in your workplace, to better appreciate the scope and variety of the Canadian avalanche industry. I'm excited by the adventures we'll share in the mountains, and also by the adventures that we'll experience as our Association continues to evolve.

All of us at the Centre value your ideas and comments about the work we do here. Please phone or email and let us know how we're doing. If you're in Revelstoke, drop by the Centre and spend a few minutes with us. We're working on having better coffee…..

Think snow!

Clair Israelson
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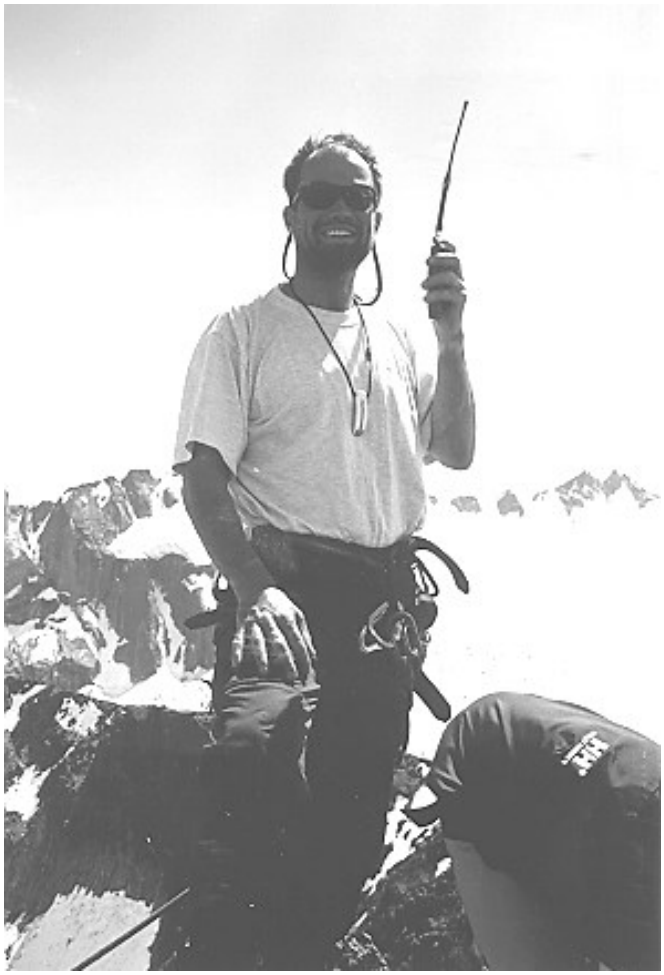
REMEMBERING KARL NAGY

On August 29, 2000 CAA Professional Member Karl Nagy died after being struck by rockfall on Mt Little, in the Moraine Lake area of Banff National Park. At the time Karl was acting as an examiner for the ACMG Assistant Alpine guides program.

Karl joined the CAA in 1993, and had a keen interest in all aspects of summer and winter mountain-craft. He pursued avalanche safety issues as he did all other aspects of the mountain experience – with an open, questioning mind and a desire to learn about everything around him. He was a Recreation Avalanche Course instructor, and excelled as a teacher and mentor.

We will all miss his easy smile, bright eyes and hair that stood straight up. The last time I saw Karl was in July at the ACC General Mountaineering Camp in the Adamants. He came out to the helicopter as we landed; happy, smiling, a man in perfect harmony with his environment. We shook hands, talked briefly, and then parted with the usual "take care". As we flew away, I never imagined this would be my last time spent with this wonderful friend, colleague and fellow CAA Member. Our community has experienced a great loss.

Clair Israelson



picture from: Ken Mitchell

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Revised September 2000

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Please feel free to contact us

with any feedback...

ON YOUR FATHER'S PASSING

A letter sent to Justin Trudeau.

Mr. Trudeau,

It was with deep sadness that the staff of the Canadian Avalanche Centre received the news of the passing of your father yesterday. Although we are aware that mere words can not come close to healing the loss and sorrow your family will be experiencing, we wish to convey our deepest sympathy to yourself and your family. Although we can not begin to understand the loss you feel as the family of this great man, after a period of moist eyes yesterday we took comfort in remembering your father's great accomplishments as a Father, Statesman and a Leader of this nation.

The quest of the Canadian Avalanche Association toward making the Canadian Wilderness a safe winter playground for all very closely aligns with your father's obvious passion for places wild and free. Your family's connection to our Association these last few years has strengthened the bond we feel, and we wanted to say to you that our thoughts and hearts will be with you as you struggle once again with grief.

The Staff and Membership
Canadian Avalanche Association

CANADIAN AVALANCHE FOUNDATION

FONDATION CANADIENNE DES AVALANCHES

Bryan Adams Live

Bryan Adams will be pledging a benefit concert for the Canadian Avalanche Foundation December 5th, Cranbrook, BC

Avalanche Awareness Days

Will be held January 12-14, 2001
Contact the Canadian Avalanche Centre for all your promotional items (banners, brochures, danger cards)

FUSE NEWS

The Explosive Committee continues to work on issues which will provide professional avalanche workers with the best possible products. Both CIL Orion and Explosives Limited supply safety fuse assemblies which have worked well this past winter season. One exception with the STAR fuse assembly supplied by CIL Orion was the high dud rate experienced during training exercises conducted by CMH and BC Highways last December.

Extensive tests were conducted to determine the cause of the failures. Although inconclusive, it appears that the cause was related to temperature and humidity cycling and possibly because of detonator crimping that restricted the burn of powder at the fuse-cap interface. CIL Orion has adjusted the amount of "crimp" on the detonator and will vacuum seal fuses in a triple bag to prevent any possible effects of temperature and humidity.

Other Products

Shock Tube

Austin Powder, in association with CIL Orion has suggested that shock tube initiation devices be considered as an alternate to safety fuse assemblies. This method of initiation has some distinct benefits over safety fuse, mainly in that duds can be retrieved immediately at no risk to the control team or the public and detonation is instantaneous (ie: no 2.5 – 3 minute wait for a fuse to burn). Austin Powder has conducted demonstrations of shock tube at several facilities with favorable results and impressions so far.

Emuline Cornice Control

Another product tested last winter was Emuline. This product is a continuous line of emulsion explosive material with a 50 grain det cord running along the full length of the explosive filled tubes. Length is 50 metres. In tests conducted late last winter at Whistler this product cleanly removed a cornice after less than 15 minutes of set-up time. Shock tube was used to initiate the shot. Emuline is simply placed on the cornice snow surface at the location where one intends to cut the cornice off. Previous missions at this same location using traditional cornice control methods have taken as long as two hours preparation time. The benefits of using this product are obvious. Not only is this method much faster, the exposure to personnel is minimized.

CIL Orion Snow Launcher Projectile

A new avalauncher projectile was introduced this past winter by CIL Orion and Austin Powder Company. This is an important product for many programs, especially in consideration of the dramatic rise in cost of avalauncher boosters previously provided by Trojan Explosives Ltd. Since Trojan has been purchased by Ensign Bickford the avalauncher projectile costs have almost tripled and provisions for long term supply is in doubt.

The Snow Launcher represents a quality product at a reasonable cost that we expect to have in place for as long as our industry uses avalaunchers.

Explosive Committee Initiatives

WCB Blasting Exam

Members of the Explosive Committee have met with WCB representatives and reviewed several hundred multiple-choice questions used in the tests. Many questions have either been deleted or revised to better reflect current procedures and practices. There will also be specific questions to

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test a candidate's knowledge of snow and avalanches in consideration of using explosives. There have also been revisions to questions regarding the use of an avalauncher and procedures for cornice control and helicopter bombing.

Qualifications of candidates interested in writing the WCB avalanche blasting test have also been discussed. In addition to satisfying the existing qualifications as defined in Regulation 21.8 there have been considerations by both the CAA Explosives Committee and WCB that candidates should have a CAA Level One endorsement as well.

The new exams are expected to be in place sometime this fall.

CAA Avalanche Control Procedures

The Explosives Committee is working on a manual to define generic products and procedures for avalanche control. It is hoped that this document can be completed in time for next winter.

Training and Certification

The CAA has been working towards identifying instructor qualifications to teach explosives control procedures. Instruction will be based on procedures as defined in the yet to be drafted CAA Explosives Control manual.

Blasting Ticket Maintenance

In an effort to ensure familiarity of products and procedures used for explosives avalanche control there have been attempts to define minimum number of missions per type of control method necessary for an individual to maintain their blasting tickets. As this is a rather sensitive issue, feedback has been sought from a diverse group, including WCB, explosive manufacturers as well as representatives from avalanche programs that regularly or infrequently use explosives.

After much discussion, there is a trend towards adopting a standard that will require a minimum number of missions per type of endorsement of five per season. In order to accommodate programs where that may be difficult, simulated training exercises will qualify as much as a live mission.

Other Initiatives and Issues:

Over the past several years the CAA Explosives Committee has become increasingly involved with both federal and provincial regulators as well as explosive manufacturers. We regularly have meetings with representatives from these agencies to express safety related concerns over products and procedures used in our industry. We have also been involved in presentations and discussions with American agencies so that they are aware of issues we are working on.

I believe the relationships we have developed and fostered over the years is of benefit to everyone. It is only through open discussion with all involved stakeholders that issues can be dealt with to everyone's satisfaction.

Mike Boissonneault
Chair, Explosive Committee

Bernie Protsch
Colani Bezzola
Bruce Allen
Niko Weis
Explosive Committee Members

LOCALS TRAIN IN AVALANCHE HAZARDS AND RESCUE

It may have been on a small scale, but local search and rescue personnel got a strong sense of what's involved in an avalanche accident response this week.

Western Newfoundland, particularly the Corner Brook and Long Range Mountain area, is prone to experiencing avalanches.

In fact, research by the Newfoundland Geological Survey has shown that snow avalanches are the most deadly geological hazard affecting the province. Since 1863, 37 people have been killed, and 28 more injured in snow slides in this province.

In the majority of those accidents, people were in their homes, going about their daily routines, when they were suddenly engulfed in snow.

The last time an avalanche came into a residential area of Newfoundland and Labrador was in Port aux Basques in 1997.

There are a number of documented cases where homes were destroyed by snow slides in the Crow Hill area of Corner Brook and a young boy died after he was buried while sliding in the Curling area of the city several years ago.

There was also an incident in the early history of the Humber Valley where a train was derailed from the tracks by an avalanche, and another incident where a man was killed after being swept into the Humber River by a snow slide as he cleared the railway track.

The Canadian Avalanche Association has been developing a competent avalanche rescue response network in western Newfoundland by holding workshops in the area the last two winters.

The need has become even more urgent in recent years as more people venture into potentially dangerous areas on snowmobiles, or on backcountry ski excursions.

Recently, the association conducted a four-day session with backcountry enthusiasts in Woody Point, helping them recognize and avoid hazards. Last weekend, the project spent two days with local adventure tourism students. The students spent one day in the classroom, while the second day was spent outside examining local terrain and discussing avalanche safety issues.

For the past four days, the focus has been on the search and rescue effort required in the event of a tragedy striking the area again.

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Taking part in the training sessions were members of the Bay of Islands Search and Rescue Team and other search and rescue squads within the province, the Royal Newfoundland Constabulary, the Department of National Defense, Parks Canada, the Newfoundland Geological Society and others with back-country recreational interests who want to be prepared to help out.

Clair Israelson of Banff Alberta has been designated by the association to manage the Eastern Canada Avalanche Project. He said the surprisingly high rate of avalanche incidents in this area's history makes it an important place to study the natural phenomenon. It also makes this region an area that immediately needs capable people who know exactly what to do when an avalanche situation arises.

"This exercise is an opportunity to help the search and rescue teams here get a sense of how a response to a damaged residence would actually have to work, and all the problems associated with having to get inside a damaged structure to get to somebody trapped inside," said Israelson. "The positive thing is that people have a chance to live for a long time if they become trapped in a structure. They can get protected from the snow by walls, hot water tanks and other things that would be in the house."

However, household items could just as easily pose a hazard for the victim or the rescuer, Israelson said.

To give trainees a feel for the situation, a simulated avalanche scene was set up at the base of Marble Mountain Thursday morning. Trainees had to locate victims buried in the snow and debris, and provide medical aid once the victims were uncovered.

"When these things happen, there have to be people in the community who know how to respond and what to do and have the knowledge to deal with these problems," said Israelson. "And the response has to come from Newfoundland itself. It can't come from Quebec or from out west. There has to be that capacity here in Newfoundland, so that you can beat the clock and get to people while they are still surviving.

"These are Newfoundlanders training to help other Newfoundlanders. This was on a small scale but they still had to do a lot of work and co-ordinate their efforts and they have been doing a great job. That's pretty heartening."

Taken from:
Friday March 10, 2000
The Western Star Newspaper
in Newfoundland
Written by Gary Kean
Star Staff Writer

DEVELOPMENT OF AVALANCHE CONTROL AT ROGERS PASS

PART II OF A SERIES BY PETER SCHAERER

Location and Design of Snow Sheds

Already the first location study revealed that snow sheds would be required. It was impossible to avoid numerous annual avalanches at Mount Tupper and at the West Boundary of Glacier National Park, and shooting with artillery there would bring down avalanche snow on the highway and require excessive snow removal work. I evaluated a variety of alternatives, for example barriers in the starting zones and earth works, but none of them was satisfactory or had a lower cost than snow sheds at the critical locations.

Unfortunately, the location of snow sheds was not finalized before the highway grade was under construction, and the sheds were simply placed on the established alignment. This resulted in horizontal and vertical curves inside the sheds, which later caused difficulties with the construction and a restricted visibility to traffic. It would have been better to determine the location of the sheds first, then to make the highway as straight as possible through them.

The length of the snow sheds was designed to allow flowing avalanches with a 10-year return interval to fall over the shed portals. The once in ten years event occurred right in the first winter at the 320 m long Lanark shed. On 1 January 1963, a large avalanche spread at an earlier deposit in the centre of the shed and submerged both portals. Two vehicles were trapped inside the shed, but suffered no damage.

Salomon Stamer and George Foures of the Structures Division of the Department of Public Works in Ottawa designed the snow sheds inside the National Park. The Province of British Columbia assigned the design of the sheds outside the park to the consulting engineers Choukalos Woodburn McKenzie Maranda Ltd in Vancouver.

The weight of deep deposited avalanche snow on shed roofs was a significant design consideration. In order to obtain information about the expected depth of avalanche snow, we surveyed cross sections of the avalanche snow surface in the spring and at the same locations later on the bare ground. Surveying avalanche deposits in the spring proved to be tricky because of the numerous avalanches on warm days. Besides having to stop work whenever the weather changed, we lost several survey stakes and pickets in avalanches. The estimates of maximum snow depth and weight proved to be correct later with measurements in 1968 and 1972, when the snowfall at Rogers Pass was a 30-year maximum, numerous avalanches occurred, and the snow sheds were loaded with deep snow.

The Pioneer shed (100 m long) was the first shed under construction. Designs in concrete, steel, wood, and multiplate steel arches were offered for tender in order to give a variety of industries an opportunity to compete for work on this first highway snowshed in Canada. The multiplate arch received the lowest price, therefore had to be accepted, although the engineers had reservations about the unproven design of an arch supported by concrete columns and its ability to withstand horizontal avalanche forces. After the construction had begun late in the summer of 1960, winter interrupted the work before the earth fill

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around the steel arch was completely in place. Soon, the partially built structure began to tilt under the pressures of the wet, irregular fill and avalanches. Although anchors were attached in the following summer, the Department of Public Works had lost confidence in steel arches and built the other snow sheds in concrete.

Earth Works for Avalanche Control

The function of earth mounds in avalanche runout zones is to decelerate avalanches and to stop them before they reach the highway. In the summer of 1957, I built six trial earth mounds, because mounds had been applied with apparent success in Austria a few years earlier, and the concept appeared to be suitable at Rogers Pass. Our first mounds were 7.5 m (25 feet) high at the Mounds avalanche path (hence the name of the path).

In the winter following, the mounds that covered one side of the avalanche runout zone stopped wet snow avalanches, and avalanches ran a longer distance at the other, open side of the path. In the next three years, the remainder of the Mounds avalanche path was covered, and mounds were placed in eight other avalanche paths. The low construction cost and suitable loose soil were the principal reasons for the extensive application of mounds at Rogers Pass. The prices for earth work were low due to a slump in the construction industry at that time.

The mounds are arranged in three lines across the avalanche runout zones and were built as closely spaced as possible. They are approximately 7.5 m high, but later experience has indicated that a height of 6 m would be more appropriate. Small mounds allow closer spacing, consequently offer a greater resistance to the motion of avalanches. In the years since the highway was built, the mounds proved to be effective in stopping slow, wet snow avalanches. They do not stop dry snow avalanches, but retain some snow of them with the effect of reducing the amount of avalanche snow on the highway.

During his early observations, Noel Gardner had noticed that the abandoned railway grade inhibited the motion of small avalanches, and he concluded that benches would be effective avalanche control means. In 1956, Noel requested and supervised the construction of experimental benches at Len's avalanche path, but avalanches were too numerous at the chosen site. In 1957, we bulldozed two additional 20 m wide benches at the more promising avalanche path Double Bench. In 1957–1959, a bulldozer was stationed near the benches, and several times in the winter, an operator pushed the accumulated snow into a wall at the edge of the bench. The benches retained numerous avalanches that would have landed on the highway grade below, however, the snow-catching wall proved to be essential for the effectiveness of the bench.

At three avalanche paths, a dike of earth was placed at the side of the highway as a means of stopping avalanches. The dikes were made of excess excavated soil that was unsuitable for highway grading, and the avalanche control dike was a welcome disposal site for the waste material.

Supporting Structures in Avalanche Starting Zone

Structures that retain the snow in the avalanche starting zones are widely used in European countries, but rarely applied in North America. The only system of supporting structures in Canada is 16 km east of Rogers Pass Summit in the Beaver Valley. The works are not visible from the highway.

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Avalanches were observed there only after the highway was partially graded below a steep forested slope. The avalanches start 250 m above the highway on exposed rock in the forest. Due to the small area, low elevation, and a low snow depth, structures in the starting zone appeared to be a viable avalanche control. Locating the structures was a quick job. On one day in April 1961, I measured the length, width, and incline of the starting zone, and marked the location with flags on trees. A week later, back in Ottawa, I determined the design specifications and submitted the project to the Department of Public Works. I left Canada a month later, and when I returned after four years, I found the supporting structures well built at the correct places. The structures engineer Salomon Stamer had designed 2.4 m high wood frames with steel cable supports.

The supporting structures in the Beaver Valley prevent large avalanches, but small avalanches start on the slope below the works. Rather than extending the works, the highway was moved later a distance of several metres from the slope. The small avalanches now run out in the wide ditch.

Transition

In October of 1959, the responsibility for making snow, weather and avalanche observations and evaluating avalanche hazards changed from the Department of Public Works to the National Park administration. Noel Gardner became the head of the operation, and Fred Schleiss and Walter Schleiss were hired as his assistants. The Department of Public Works retained three observers for an additional winter. Their task was to monitor the effectiveness of the built and planned avalanche control works.

Because it was not necessary for me to remain at Rogers Pass, I began to occupy a desk in the laboratories of the National Research Council at Ottawa. I wrote the reports on the design of the avalanche control works and on the organization of avalanche forecasting an made several inspection visits to Rogers Pass. In 1961, I concluded that my task was complete, and, after presenting a final paper at the annual meeting of the Engineering Institute of Canada, I returned to Switzerland.

New Start

In 1964, when working as a highway engineer in Switzerland, I received and accepted the attractive offer of resuming my position with the National Research Council of Canada. My initial task with the Research Council was to develop snow removal and ice control techniques for roads, including the application of chemicals and heat. I visited Rogers Pass in January 1965 for making observations of the performance of the avalanche control. At that time, Noel Gardner directed the avalanche control and safety operation from the high level observatory at Fidelity Mountain. Fred and Walter Schleiss carried out the observations at the highway.

My director Dr. R.F.Legget, recognizing a future demand for expertise in avalanche control, decided that we should resume avalanche research rather than snow removal studies. Subsequently, another chapter of avalanche research at Rogers Pass began in 1966 and ended in 1991. This research and the rapid development of avalanche safety and control in Canada during these years are another story.

MOUNTAIN PROFESSIONLS ESSENTIAL COMMUNICATIONS INITIATIVES

Some Personal Thoughts

BY COLONEL PHIL ENGSTAD (RET'D)

Professionals within all organizations strive to focus on areas which produce the best possible results for themselves, their clients and their profession. Each expects success; a combination of their leadership and the dedication and hard work of all members of their team. The challenge for all becomes one of how to lead your people through the maze and fog of the predictables and unpredictables of today, tomorrow and onward. There are many factors which combine to dictate the final results but one of the most important often-neglected keys to individual and corporate success, is good solid face to face/multimedia communication. How each mountain professional communicates with his/her personnel, peers and the broad spectrum of public at large who on a daily basis are showing a growing interest and determination to participate in what you as mountain professionals have to offer them, has never been more important.

As mountain professionals you are clearly aware of this requirement and have in fact excellent avenues for ongoing communication such as your annual Workshop and your Avalanche News magazine, your courses, briefings and videos, etc. This said, it is always beneficial to revisit this issue for a quick how-goes-it to confirm that everyone is really doing all they can.

You have each earned and worked hard for the credentials you have, and they demand your complete attention across the full spectrum of your individual operations and initiatives. This entails "second to none " instruction and training for your new staff and the leaders on your team. It includes the provision of accurate, up-to-date operational directives and standards, and a clear specification of current pursuits and future initiatives. It also includes, a crystal clear state of the union message face to face from the boss himself to ensure that everyone understands that anything less than total professionalism, dedication and superior performance is just not acceptable.

External to your organization, it is important to communicate regularly with your counterparts in the industry. At times there is a degree of hesitation to share with the competition, however to proceed positively in this area means: to realize the best in your profession; to learn from each others mistakes; to reduce "trial and error" workload or "reinventing the wheel"; to benefit from each others expertise and individual strengths; to tap each others "old boy net"; to develop the broadest possible Province, Canada and World Wide contacts; and most importantly assist each other in determining the best collective goals, priorities and direction within your profession. In this vein, it is important that each dialogue participant pursues the courage of his/her convictions to the fullest, and activates their personal performance envelope to the maximum, all without fear of making mistakes or failure.

It is this above-mentioned honest, open, shared and widely disseminated communication at all levels that will keep the industry healthy and make each of you collectively the drivers, salesmen and saleswomen of today's mountain programs, requirements and initiatives. **Most importantly** however, this open and perseverant dialogue will ensure that each and every one of you becomes the author, inventor and salesperson of **tomorrow's "mountain initiatives".** This ability to consolidate your credentials, to influence events and make it happen is surly a challenge worthy of pursuit. Think about it!

Colonel Phil Engstad (Ret'd) MSM, CD2
Can be reached at:
Phone & Fax: (250) 825-9215
E-Mail: groundedeagles@uniserve.com

Colonel Engstad was one of North America's Top Gun fighter pilots before his retirement from the Canadian Air Force. He continues to find the similarities between his profession and the avalanche safety industry as stimulating as when he was a feature speaker at the 1999 AGM.

EXPLOSIVES TRAINING
A REAL LIFESAVER

As explosives sellers we, as with most of our confreres, rate user training as one of the most important components of safe blasting practice. We also know that as a company we cannot get to see every client and each of their practitioners so we must find a method that does that.

The perfect vehicle as far as we are concerned is the CAA. Here is an association that has an extremely high membership percentage - a group that is not product partisan so they are in the perfect position to deliver the best and most unbiased safety training.

During our visits with our clients and friends, the advice we got was to use marketing rebates to support independent training. We felt that this was in fact a most positive thing to do and armed with the support of our clients we committed ourselves to a CAA programme. Under this programme we dedicate ourselves to returning the CAA on a monthly basis, 3% of all the explosives sales we make to the avalanche industry. The only condition we place on this return is that it be used in it's entirety to support the CAA Explosives Safety Training Programme.

Training, in our mind is terribly important for those starting out in the business and those coming into their own in a journeyman approach but we also know that seasoned veterans need to be involved in training. Not only can they contribute significantly but it keeps us from getting blase and carelessly familiar - we are always working with explosives no matter what product progress is made.

We want to thank everyone who supports this programme and wish for a productive and successful season.

C·I·L / ORION

Explosives EXPERTS Explosifs

Div: EVANinc

SnoRiders WEST

FAX: (250) 426-4125

October 4/2000

Re: Publisher's Choice Award

Attention: Managing Director

As you are aware we recently published our Fall 2000 edition of SnoRiders West magazine. This edition contained our 2nd annual Riders Choice awards. As a new feature this year, we decided to add the Publisher's Choice award category.

This new category is designed to be presented to an individual or organization to recognize outstanding achievement in enhancing the sport of snowmobiling and/or ATVing.

I am pleased as publisher of SnoRiders West magazine to present the Canadian Avalanche Association with the SILVER award for your outstanding achievement in enhancing the safety of the sport of snowmobiling.

Congratulations, your efforts in developing in raising avalanche awareness certainly warrants special recognition.

Sincerely,

Keith Powell
Publisher

BOARD OF DIRECTORS STRATEGIC PLANNING

CAA Visioning Process – April 8 - 9, 2000

Following an in depth review of the member survey, the CAA Board of Directors and past Presidents agreed upon a vision statement for the Association. The intent of the vision statement was to identify where the Association hoped to be in the year 2005, thus setting a point of reference to guide Board planning. The draft agreed upon drew heavily upon both the strong direction given by the member survey and the unanimous feelings of the participants.

Vision Statement

The Canadian Avalanche Association will be the Canadian professional authority on all aspects of snow avalanches. The CAA will:

- promote high standards of avalanche risk management,
- act as the primary agent in the development, maintenance and delivery of avalanche education standards and courses;
- will be the primary point of professional interaction with other organizations, agencies and the public;
- will promote research and development in avalanche safety; and
- will develop, provide and promote high levels of public avalanche awareness.

With respect to its membership, the CAA will:

- continuously review, improve and promote a comprehensive set of high standards for the avalanche profession;
- ensure high ethical standards, promote pride of membership, and provide opportunity for involvement;
- provide an effective communication infrastructure for avalanche professionals;
- and operate in a financially secure environment where the value of the services of the Association and its members are nationally recognized.

Mission and Purposes

The participants confirmed a **mission statement** defining the Association along with its purpose and objectives:

> "The CAA is a non-profit society dedicated to bringing together avalanche professionals to develop knowledge and understanding of avalanches, to encourage communication and promote industry standards, and to provide high quality avalanche education. "

The **statement of purposes** from the CAA constitution was also confirmed:

- **To represent persons who are professionally engaged in avalanche work in Canada;**
- **To establish and maintain high standards of professional competence and ethics for persons engaged in avalanche safety programmes;**
- **To exchange technical information and to maintain communications among persons engaged in avalanche safety programmes;**
- **To establish and maintain standards of education in avalanche safety;**
- **To organize training courses in all aspects of avalanche hazard control for professionals;**
- **To promote and act as a resource base for public awareness programmes about avalanche hazards and safety measures; and**
- **To promote research and development in avalanche safety.**

INTERNATIONAL SNOW SCIENCE WORKSHOP 2002

"A merging of theory and practice"

The site chosen for the next ISSW in 2002, is Penticton, British Columbia. The conference will be held October 6th to 10th, 2002.

We are in the beginning phases of preparation for ISSW 2002, with the confirmation of facilities and the soon to be available ISSW web-site.

The Canadian avalanche community excels in many areas of the snow avalanche profession. I encourage you to participate in this conference; whether it is presentation of papers or posters, or attendance at the conference. I would also like to encourage a higher level of participation from the guiding community, an area of avalanche expertise that has been under represented in past ISSWs.

The development and management of this international conference requires support and participation from the Canadian avalanche community. There are a wide variety of activities that we could use your support.

If you are interested in the opportunity to participate in the organization of ISSW 2002, please contact:

Jack Bennetto
Chair
(250)387-7523
Jack.Bennetto@gems8.gov.bc.ca

Nic Seaton
Co-chair / Facilities Coordinator
(250) 487-4771
Nic.Seaton@gems5.gov.bc.ca

STRATEGIC PLANNING – IMPLEMENTATION TO DATE

Following discussions with the CAA membership at the Annual General Meeting last May in Penticton, the CAA's Board of Directors agreed that implementing the consultant's recommendations from the strategic planning session in April was a high priority. Accomplishments to date include:

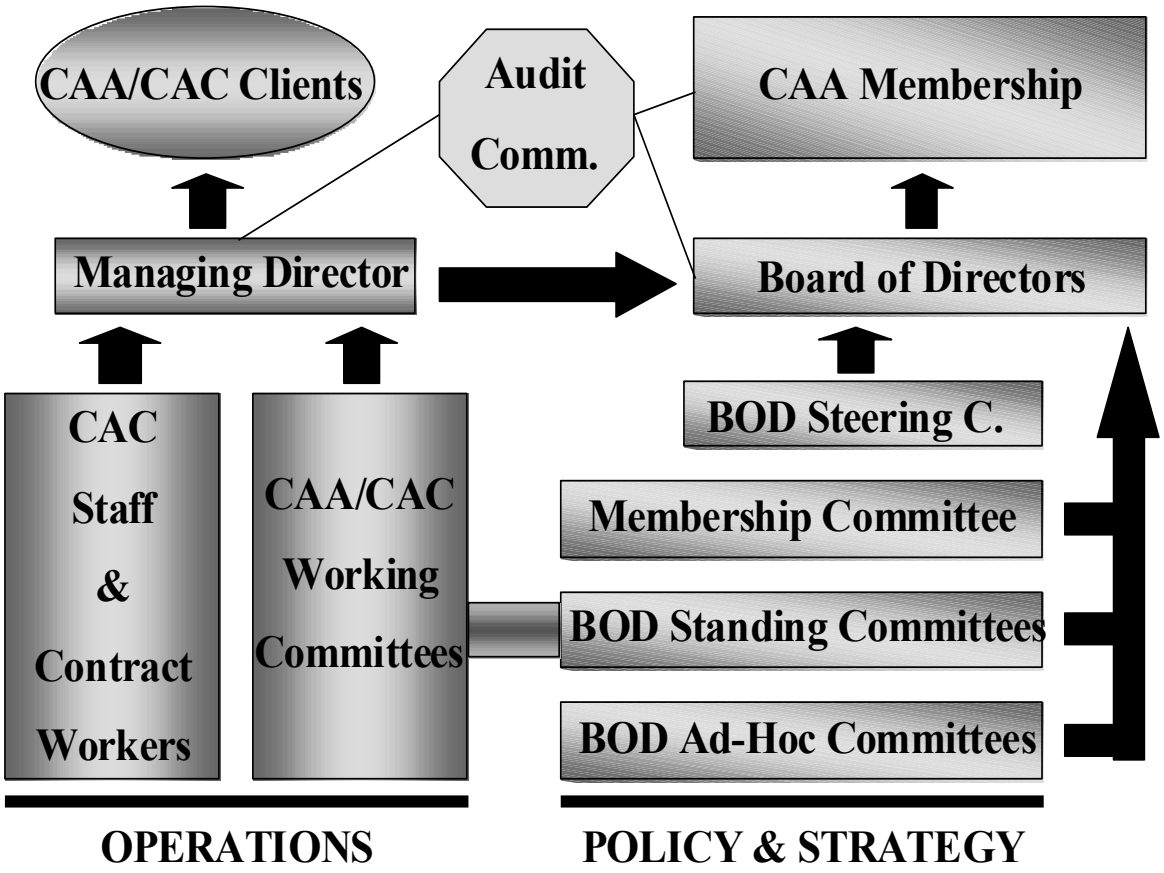
1. Development and adoption of an interim CAA /CAC responsibility and reporting relationships document, defining responsibilities and accountabilities for all CAA activities

2. Development of interim CAA policies for:
    - Contractor Selection
    - Conflict of Interest
    - Management of Intellectual Property

All of these documents have been approved as "interim" by the Board of Directors. It is the intention of the Board to "test drive" these instruments for a year or so to ensure they are fully appropriate for our needs, before adopting them as final. Copies of these interim policies are available from the Canadian Avalanche Centre. The CAA/CAC responsibility and reporting relationships document is shown below in it's entirety. The Board of Directors and the Managing Director welcome any comments you may have regarding these developments

Adopted INTERIM CAA / CAC Responsibility & Reporting Relationships

Adopted INTERIM CAA / CAC Reporting Structures



1. **Canadian Avalanche Association (CAA) Membership**
   - "Owners" of the CAA as "shareholders" through annual payment of dues
   - Authorize constitutional changes, approve financial statements and Directors reports
   - Elect the Board of Directors to represent their interests and manage the activities of the CAA

2. **Audit Committee**
- Volunteers to the CAA.
   - The Audit Committee is comprised of the past Presidents of the CAA. Their role is to monitor the activities of the Association, provide advice to the BOD and Managing Director, and report to their observations to the Membership.

3. **Board of Directors (BOD)**
   - The BOD reports to the Membership
   - Hold legal responsibility for all Association activities
   - Must approve all CAA / CAC budgets
   - Develop annual financial statements and Directors reports for approval by the Membership at the Annual General Meeting (AGM)

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- Develop and/or approve policies and strategic direction for the proper conduct of CAA activities
- Responsible for executive oversight all CAA activities for compliance with approved budgets, business plans, policies and strategic direction
- The President, Secretary Treasurer and one other Director comprise a standing Steering Committee (BODSC) with delegated authority to decide urgent issues. BODSC decisions subject to ratification by the BOD at their next meeting

President

- A volunteer to the CAA
- Legal Chief Executive Officer of the CAA
- Chairs the BOD
- Portfolio: CEO responsibility for all CAA activities, and for the executive oversight of the operations of the CAC

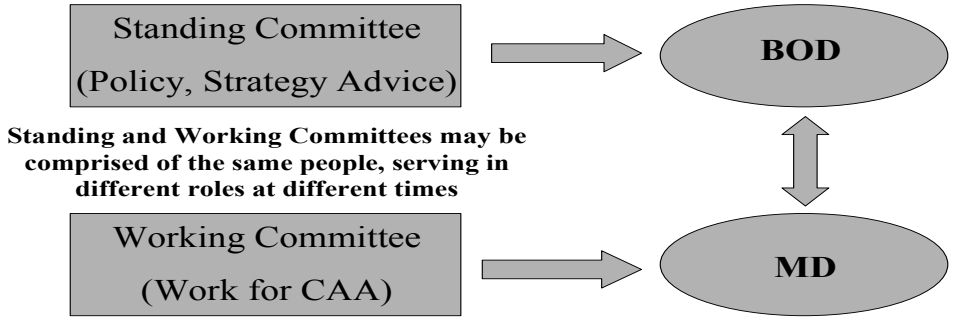
Directors

- Volunteers to the CAA
- Legal Officers of the CAA
- Hold BOD portfolio responsibilities as assigned in the Constitution or by the President

4. Membership Committee

- Volunteers to the CAA and BOD
- A unique Standing Committee with structure and responsibilities specified in the Constitution.

CAA/CAC Committee Operations Structure



5. Standing Committees

- Standing Committees are volunteers to the BOD, and are creatures of the BOD.
- Standing Committees make recommendations to the BOD, and conduct other activities in support of the BOD function (CAA policy and strategy) according to Terms of Reference and other instruments as may be approved by the BOD.
- The Chairperson of a Committee is responsible for the activities of that Committee, and reports to the BOD.
- The BOD will select the Committee's Chair. Committee members will be selected cooperatively by the Chair and the BOD, to achieve diversity and an effective working environment.

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6. Ad Hoc Committees

- Volunteers to the BOD
- May be constituted and disbanded at the discretion of the BOD.
- Report to the BOD
- Conduct specified activities according to Terms of Reference approved by the BOD

7. Canadian Avalanche Centre (CAC) Operations

CAC Staff

- Employees paid by the CAA to conduct it's business activities.
- Responsible to represent the CAA and CAC to clients. (Clients are defined as persons or parties who bring value to the CAA or the CAC in return for benefit)
- May liaise with the CAA membership, BOD, Standing Committees, Working Committees, clients and the public to properly conduct the business of the CAA and the CAC

Managing Director (MD)

- Reports to the BOD through the President
- Responsible to manage the business of the CAA and CAC operations in accordance with budgets, business plans, policies and strategic direction approved by the BOD
- Upon request, assists the Board in the development of tools required for the good and prudent management of CAA and CAC activities
- CAC staff and contractors are supervised by, and report to the MD
- CAA/CAC Working Committees report to the MD when their work is for, or in support of CAA/CAC operations.

Working Committees

- Working Committees conduct specified activities in support of the CAA operations function according to Terms of Reference and other instruments as may be approved by the BOD.
- Working Committees may be volunteer, or paid to conduct specific (onerous) tasks, at the discretion of the BOD.
- The Chairperson of a Working Committee is responsible for the activities of that Committee, and reports to the Managing Director.
- The Managing Director will propose the structure and composition of Working Committees, for approval by the BOD.

Following each CAA Annual General Meeting, the names and contact information for members of the BOD and Standing Committees will be complied and circulated to the membership.

Adopted as INTERIM by the CAA Board of Directors, 00/10/05 at ISSW 2000.

MINUTES OF THE PUBLIC AND TECHNICAL MEETING

MINUTES OF THE PUBLIC AND TECHNICAL MEETING
OF THE CANADIAN AVALANCHE ASSOCIATION - MAY 3, 2000

The meeting was called to order by President Bruce Allen who welcomed all to the meeting. The president encouraged people to vote for the upcoming awards for Rookie of the Year, Life Time Achievement, Professionalism and Volunteer of the Year. The President encouraged interaction with other members and CAC Staff. Bill Mark introduced the afternoons speakers.

Research - Dr. Dave McClung

Topics discussed included recent research on; Magnitude and Frequency of Avalanche Related to Terrain and Forest Cover; Terrain, Forest Cover, Snow Supply for Avalanches in Clear Cuts; Avalanche Forecast Classifying Predictions; Return Period of Avalanches and Superelevation around channel bends. Some recent Journal Articles include - Avalanche Risk, Return Period of Avalanches, Predictions in Avalanche Forecasting, Superelevation, Elements of Avalanche Forecasting, Statistical Analysis of Runout and Magnitude and Frequency of Avalanches. Dave is currently working on a project to be able to computer monitor avalanches with an intensity of 1 station per square kilometer. $1.4 million in research funds will be needed to complete this project. Recent data from Switzerland shows that most fatalities occur in the moderate to considerable range with very few fatalities occurring in a class 5 avalanche. Recent data from France and Switzerland show the highest number of deaths to be in the considerable, high and extreme categories with all 3 the same. His concept is to do away with the Class 5. There is currently European opposition to this concept.

Future Projects - Evan Manners

Talked about concerns over funding delays with the NSS for current approved projects. All aspects of the project ADAPT (Avalanche Decision Making and Professional Training) were discussed as well as the project Developing Avalanche Hazard Evaluation and Mapping Capability. The Risk Management meeting in June in Lake Louise was also discussed.

CAC Report - Evan Manners

Evan talked about the positive aspects of the winter with lower than average severe incidents. The Center continued to get healthier this year due to good staff and no major staff turn overs. Financial restraint was extreme this past year. The Board of Directors ran on a shoe string budget. There was good Industry support which helped to put the center in a positive financial position. The closing of the center during the summer months July and August reduced costs and revitalized long term staff. Involvement's and fatalities were down this year. Involvement's and fatalities were summarized by region. There was some discussion about the definition of Out of Bounds and Backcountry. Evan talked a bit about Richard (former Office Manager) leaving the center and staff opinions concerning this matter. Accomplishments this past year include the book, Free Riding in Avalanche Terrain, A Snowboarder's Handbook by Bruce Jamieson and Jennie McDonald. This was a great success and was mostly a volunteer effort by Bruce Jamieson. The center provided much support to the CAF (Canadian Avalanche Foundation). Avalanche Awareness days were much larger the second go around. Calgary and Vancouver were quite well attended. There was lots of membership participation. Interaction with the media is becoming more positive. There are hopes in having an improved News Letter this year. The web page has a new design. There was a 30% response to the Membership Survey. French translation is ongoing. This was the 10th year of Infoex. Infoex had 62 clients this season. Material sales have increased to $65,000.00 from 4 years ago when yearly sales were $3,200.00.

Eastern Canadian Avalanche Project - Clair Israelson

This initiative started several years ago. Clair started out by thanking all those involved, Susan Hairsine, Bruce Jamieson, Randy Stevens and Phil Hein. Thank to the NSS and Parks Canada for helping with funding. Clair talked about each of the Co-operating Organizations and also about the Project Design Criteria and Project Delivery. Clair believes that ECAP was a reasonable success and will be a long term project. Recommendation to extend eastward when appropriate.

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Snow Smart - Dave Smith

This is a youth program for 12-18 year olds including all winter activities. Smart Risk is supporting this program. This program started in 1997 and is now at the research stage. There was a commitment from the NSS for some funding but the money was delayed for 3 to 3.5 months. This commitment was lengthy enough that the project manager was laid off and has since found another job. We are now interviewing for a new manager. Gord Ritchie stated that the ski patrol has been educating students for the past 3 years. Approximately 1500 students in Calgary and 3300 in Vancouver have already been spoken too. Bruce Allen mentioned that it may become part of the school curriculum to take Avalanche Safety Programs. Lake Louise Ski Patrol started organizing mini lessons for the schools originally and Snow Smart was there from the start. The research phase to terminate in a few months.

Forestry - Peter Weir

Peter Weir is a Forestry Consultant based in Salmon Arm. Peter is presently preparing The Land Management Handbook for The Ministry of Forests. Peter thanked the photographers for their addition to the book. Peter talked about the Management of Snow Avalanche Prone Forest Terrain. Topics included; Snow and Avalanche Phenomena, Avalanche Risk Calculation, Minimal Avalanche Proneness and Resource Loss and Managing Avalanche Risks in the Winter. Forestry is falling behind in snow management. Peter has developed a Risk Matrix and also set some guidelines for management of avalanche prone areas. The guidelines should be complete in about a years time.

Explosives Training - Mike Boissenault

Mike is the chair of the Explosives Committee. Topics discussed include; Fuse Issues, Recent Involvement's and Issues and Initiatives by the Explosives Committee. On fuse issues Mike stated that fuses were more suspect in the past. Fuses have been much better in the past two years. There were a few incidents this past year. The report should be in soon concerning these cases. Duds were isolated incidents for the most part. Mike was invited to talk this past year at the Regulators meeting in Vancouver, Washington to talk on Avalanche Explosives. The US have diverse regulations for each state and some have no regulations. Mike would like to see industry wide regulations instead of state wide regulations concerning explosives. He left the conference with some recommendations, some of which include that explosives users should have testing on explosives and avalanche phenomena and that there should be a standardized fuse length and burn time. The Explosives Committee have regular meeting with explosive providers and regulatory people. Some of the Issues and Initiatives put forth by the Committee include; we cannot afford another serious explosives related incident, peer responsibility-the actions of a single individual can adversely affect the entire industry, CAA is developing generic avalanche control procedures, provide a training program for specific avalanche conditions procedures, CAA is working with WCB to create a more applicable exam, CAA proposes to raise existing qualifications necessary to obtain an Avalanche Control Blasting Ticket, seek funding from WCB for training and to have an Avalanche Control Blasting Log. Mike talked about Avalanche Control Training in regards to WCB, Regulations 21.2 and 21.8. Some proposed changes for maintaining a blasting certification over a 5 year term include; min of 5 missions total, one mission or each type of ticket, if only 5 missions all must be in final 2 years prior to expiry date (training exercise would suffice, each mission must have one live round). The CAA Explosives Training would need manuals, funding support, definition of instructor qualifications, training packages offered to candidates who meet qualifications and would like to have this ready by next fall.

Canadian Avalanche Foundation - Chris Stethem

Chris talked about the mission of the CAF, sources of support and fund raising.
Bill Mark closed the meeting by reminding everyone to place their ballots in the box for the awards for Lifetime Achievement, Volunteer of the year, Rookie of the year and Professionalism award. He thanked all for attending the meeting.

71 signed the attendance sheet.

MINUTES OF THE PUBLIC AND TECHNICAL MEETING OF THE CANADIAN AVALANCHE ASSOCIATION - MAY 4, 2000

The meeting was called to order by Bob Sayer.

Incident Profile - Mark Austin

Mark gave a comprehensive report on an incident that happened in the vicinity of the Whitewater Ski Area this winter. Slides were shown of the area involved. The group of four ski tourers had split into two groups of two. The first party entered the slope and triggered a size 2.0 avalanche. One person was carried 150m down slope and was buried except for one gloved hand sticking out of the snow. Observers from the ski area rushed over to rescue the victim by digging out the person by hand. Ski Patrol cleared the accident area of people as the area was considered unsafe. Moments later the 2nd ski touring party unaware of the incident below entered the slope from above and started another avalanche which carried one skier through the trees. The debris from this second slide covered the area of the previous rescue site. There was a 3rd party of ski tourers also on their way to ski the same slope unaware of the problems below. There had been widespread size 2.0 avalanches the previous day and a natural size 2.5 the morning of the incident.

Bob Sayer reminded members to vote for the awards and then introduced Bruce Jamieson as the next speaker.

Research - Dr. Bruce Jamieson/Research Assistants

Bruce thanked all the sponsors, private sector, Dave McClung for providing equipment, current personal and current collaborators. Bruce talked about current projects. He presently has seven projects on the go. Charts were shown on the overhead correlating weather factors with avalanches. The Rank Correlation Table will be useful for predicting avalanches. Research Assistant Torsten Geldsetzer did a presentation on Estimating Density Kg/m3. Greg Johnson did a presentation on Strength Changes and Layers of Facets and Crystals in the Columbia and Rockies. Ben Johnson did a presentation on Fracture Propagation and Remote triggering. He talked about the theory of whumphs and remotely triggered avalanches. The Cantilever Beam Test was used in the field studies. Al Jones then talked about a 10 year data set on weather and snowpack observed in Blue River from 1990 to 1998. This information is to be used for forecasting factors for skier triggered avalanches. Bruce Jamieson then showed slides of surface hoar development and compared layers from Dec 30, 1999 to Feb 21, 2000. Bruce finished his session by talking about current projects and also that he was looking for good ideas for current projects.

Jack Bennetto talked about the up coming ISSW from Oct 6-10, 2002. Canada is hoping to host this event. We have a lot to offer; railway lines along avalanche paths, wine tours etc. This idea will be brought forward at the ISSW in Montana. The Avalanche Mapping Course will be held Sept 26 to Oct 1, 2000 in Nelson. This is advertised on the CAA web site as well as Forestry Continuing Sites. Jack introduced the next speaker Scott Aitken.

Incident Report - Scott Aitken

Scott reported on an incident in the Wasp Creek area 20 km West of Pemberton on March 19th where one skier was killed in an avalanche while guiding a private heli-ski group. The day previous to the incident there had been significant winds at 125 km per hour. Alpine lifts in the area were closed on the 18th due to the winds. There was 28cm of new storm snow on the 19th. The incident occurred at 1400hr on the 8th run of the day on a run that was previously skied on the 2nd run of the day. The avalanche was triggered near the top of the run. The victim was carried 200m and then another 70m vertical over a cliff and was found buried with the head down 2m. It took just over 10min with five people digging to recover the victim. Cause of death was asphyxiation. No major trauma. The release layer was shown to be well preserved stellars. The avalanche was a size 3.0. In summary the day of the incident saw new snow events, numerous shears in the upper snowpack, high winds and a weak interface due to warm temperatures. Temperatures were near zero Celsius. The confined runout zone made for a deep burial. The same heli-ski group had seen several size 1.5 and size 2.0 avalanches earlier in the day as well as some size 2.5 and 3.0. The group was bumping up the risk level further into the day.

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Incident Report - Bruce McMahon

Bruce reported on an incident that took place in the Roger Pass on Dec 7, 1999 where one ski tourer died of serious trauma injuries. This incident happened on a popular run the first sunny day after a storm. There were five people in the accident party of which three have a level one and some with guiding experience. The avalanche was a size 3.0 skier triggered. Several groups of people including two level one course groups were on the same slope at the time of the avalanche. It was not certain at the time how many people were involved. The avalanche was triggered on a crust layer. The crown was 130cm deep. The temperatures were mild and there was 30cm of new snow that day as well as new snow the two days previous to the incident. The ski tourers had seen propagation around skis earlier but continued up route. The group had been spread out on a ridge when route finding became difficult. One person went out on a pillow and then turned back to find a better route. The skiers had just regrouped when the avalanche was triggered. The daily Avalanche Bulletin at The Rogers Pass Centre had been read by the group at the start of the day and it clearly indicated the instability.

The meeting was adjourned at 1700 hrs.

73 signed the attendees list.

BACKCOUNTRY AVALANCHE AWARENESS UPDATED!

Dr. Bruce Jamieson, noted Canadian author of several books on avalanche safety, has just put the final touches to the seventh edition of Backcountry Avalanche Awareness, published by the Canadian Avalanche Association. Although the cover remains virtually identical to the sixth edition, the book now contains 78 pages of information, up from the 42 pages in the previous edition. Pricing remains unchanged despite the fatter book. While the sixth edition was still climbing in sales at the start of the rewrite, the author wanted to incorporate into Backcountry Avalanche Awareness what he had learned while writing the companion books in the series. Backcountry Avalanche Awareness remains focused on the backcountry skier, while the companion books Sledding in Avalanche Terrain and Free Riding in Avalanche Terrain focus on backcountry Snowmobiling and Snowboarding respectively. The French language Backcountry Avalanche Awareness will remain as the sixth edition while the publisher explores funding partnerships for the translation of the rewrite.

All these books are available:
online at www.avalanche.ca or by contacting Audrey Defant
at the Canadian Avalanche Centre (250-837-2435, audrey@avalanche.ca).
Thank you Bruce for all the hard work during the summer season!!

CASE STUDY OF A DEEP SLAB INSTABILITY AND ASSOCIATED DRY AVALANCHES

Bruce Jamieson [a, b, *], Torsten Geldsetzer [a], Chris Stethem [c]
[a] Dept. of Civil Engineering, University of Calgary, Calgary, Alberta, T2N 1N4, Canada
[b] Dept. of Geology and Geophysics, University of Calgary
[c] Chris Stethem and Associates, Canmore, Alberta, T1W 2R8, Canada

Abstract

This study considers the predictive merit of weather and snowpack data for avalanches that released throughout the winter on a layer of faceted crystals that formed on a rain crust in November 1996 in the North Columbia Mountains of western Canada. The facet-crust combinations formed as a result of a cold air mass cooling a layer of dry snow on top of a rain-wetted layer. The highly ranked variables associated with natural avalanches include previous avalanche activity, accumulated snowfall over several days, changes in air temperature over four to five days, snowpack properties, including a shear frame stability index, and the difference in hardness between the facet layer and the crust. Increases in air temperature over four to five days correlate with increased avalanche activity, however current theories for warming do not explain decreased stability especially where the slab is thick. We argue that the fractures that release slab avalanches may be initiated where the slab is locally thin.

Keywords: Avalanche forecasting, avalanche formation, faceted crystals, snow cover stability, snow cover structure, snow stratigraphy

1. Introduction

Avalanche forecasters report that the stability of deep slabs is difficult to forecast. Consequently, large explosive charges are sometimes used to test the stability of deep slabs (Wilson, 1978).

In mid-November 1996 a weak layer of faceted crystals, subsequently referred to as November facets, formed on a much harder crust. This facet-crust combination was widespread, releasing fatal avalanches in the Coast Range, the Columbia Mountains and in the Rocky Mountains of western Canada. In the North Columbia mountains, dry slab avalanches, many over 150 cm thick, were reported on this layer until mid March 1997 and many wet slab avalanches, not considered in this study, occurred in May and June 1997.

Manual snowpack and conventional meteorological measurements are used to determine the dominant weather and snowpack factors associated with the formation of the facet-crust combination and the occurrence of the deep slab avalanches that occurred naturally on this facet-crust combination.

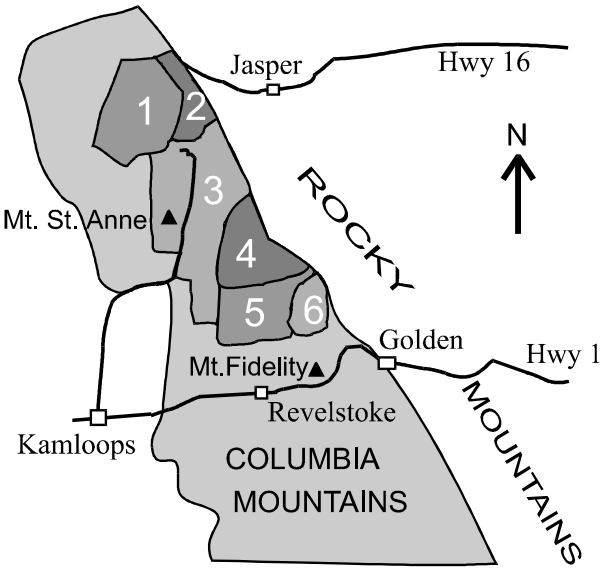

Figure 1. Map of Columbia Mountains including six forecast areas as well as locations of weather stations and study plots at Mt. St. Anne and Mt. Fidelity. The North Columbia Mountains are north of Highway 1.

2. Literature Review

Atwater (1954) identified eight weather and two snowpack factors associated with avalanching. Focusing for large avalanches near Alta, Utah, Perla (1970) found precipitation and wind direction to be the most important factors. McClung and

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Table 1. Definitions of weather and snowpack variables

Meteorological measurements		
HS	m	Height of snow on ground, measured vertically
HN	cm	Height of new snow that fell in 24 hours
T_{MIN}	°C	Minimum air temperature in 24 hours
T_{MAX}	°C	Maximum air temperature in 24 hours
Calculated meteorological variables		
HST	cm	Sum of HN since last day with HN < 0.3 cm
Σ_MHN	cm	Sum of HN over the last M days including the current day
$\Delta_M T_{MIN}$	°C	Change in T_{MAX} over last M days
$\Delta_M T_{MAX}$	°C	Change in T_{MIN} over last M days
Snowpack measurements		
H_{SLAB}	cm	Slab thickness, measured vertically
σ_V	kPa	Load: weight per unit horizontal area of slab overlying weak layer
F		Grain type of weak layer (Colbeck et al., 1990)
E	mm	Largest dimension of particles (Colbeck et al., 1990), often a range
T_{WL}	°C	Temperature of weak layer
TG	°C/m	Temperature gradient of weak layer
h_{WL}		Hardness index of weak layer of facets using hand hardness scale
h_{SUB}		Hardness index of crust (substratum) below weak layer
Calculated snowpack variables		
Δh_{SUB}		Hardness index of crust minus h_{WL}
S_{N38}		Stability index for natural avalanches (Jamieson, 1995)

Tweedy (1993) report that various measures of precipitation, wind direction and wind speed correlated best with avalanche activity along the highway through Kootenay Pass, British Columbia. Avalanche books for recreationists (e.g. Fredston and Fesler, 1994) consistently emphasize the importance of precipitation, wind, air temperature and snowpack stratigraphy for forecasting avalanche hazard.

Slab avalanches require a slab consisting of one or more layers of cohesive snow overlying a weak layer or interface. Although weak layers of faceted crystals can form under crusts (e.g. Seligman, 1936, p. 70) the weak layer in this study consists of faceted crystals overlying a crust. When cold dry snow falls on a wet snow surface, latent heat from the wet layer creates a temperature gradient favourable to faceting of the overlying dry snow (Armstrong, 1985; Fukuzawa and Akitaya, 1993; Birkeland, 1998; Colbeck and Jamieson, 2000). Once buried by subsequent snowfalls, the faceted layer may remain weak while overlying layers gain strength and stiffness due to equilibrium metamorphism which is usually dominant in the deep snowpack of the Columbia Mountains.

3. Methods

Weather measurements were averaged from automatic weather stations at Mt. Fidelity (1905 m) and Mt. St. Anne (1900 m) and checked with manual observations. Mt. Fidelity and Mt. St. Anne (Figure 1) are at tree-line and close to the starting elevations of many of the avalanches considered in this study. For this study, daily values were obtained by combining the morning reading with the previous afternoon reading to obtain values for the 24-hour period similar to the reporting period for avalanches. In this study storm snow HST is the accumulated the daily snowfall values from meteorological instruments since the last day with less than 0.3 cm of snowfall.

Manual snow profiles (CAA, 1995) observed periodically during the winter include measurements of slab thickness H_{SLAB}, temperature of the weak layer T_{WL}, temperature gradient across the weak layer TG from temperature measurements 5 cm above and 5 cm below the facet-crust interface, grain form *F,* and grain size *E* of the weak layer (Colbeck et al., 1990). The hand hardness index (Geldsetzer and Jamieson, 2000) for the weak layer (h_{WL}) and the crust below the weak layer (h_{SUB}) were also observed. The load (weight per unit horizontal area) over the weak layer is calculated from density and thickness of the overlying layers. Alternatively, the load was determined by dividing the average weight of core samples from the surface to the weak layer by the cross-sectional areas of the cylindrical sampling tube. The shear strength of the weak layer was measured with the

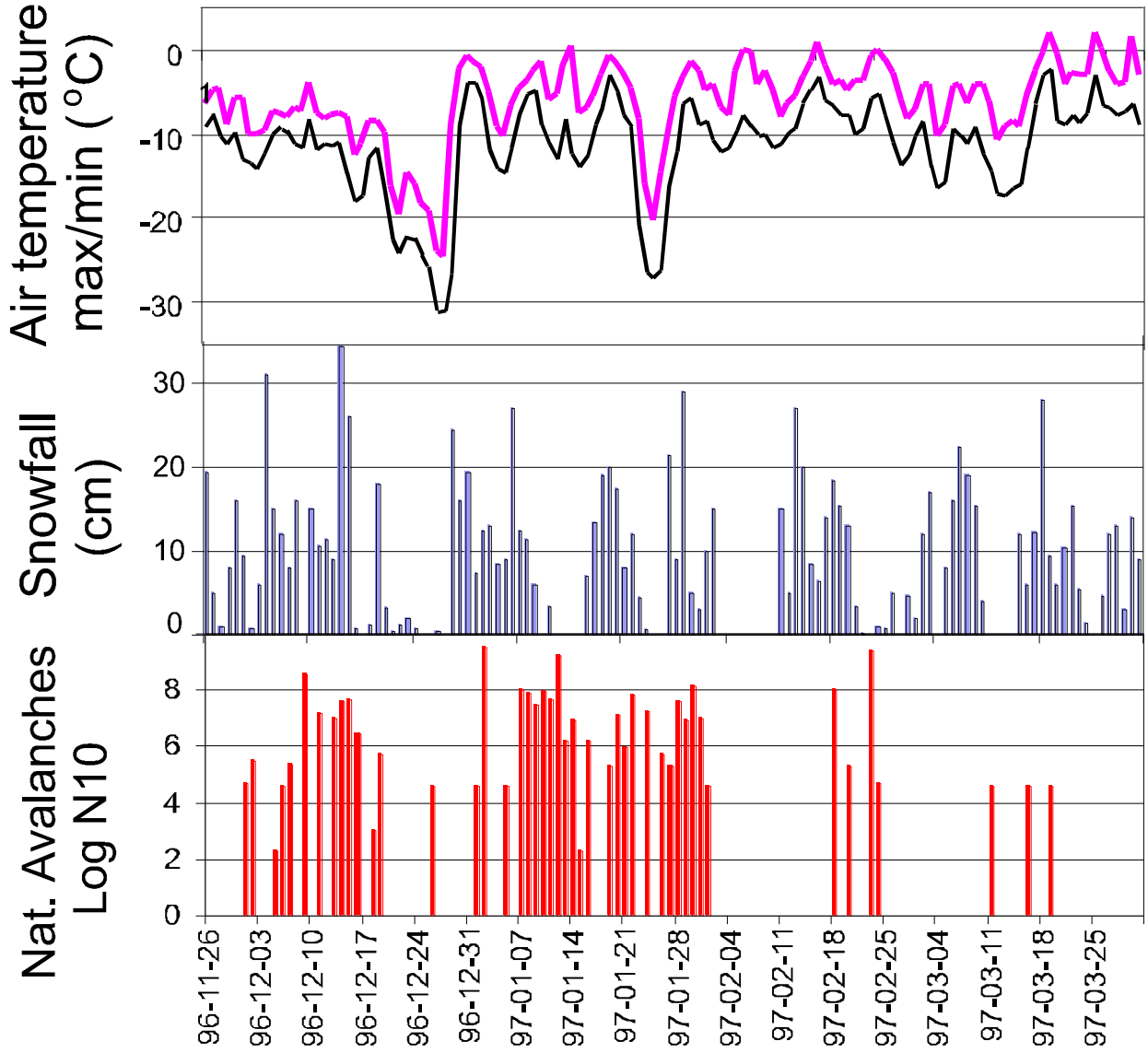

Figure 2. Weather and natural avalanche activity for facet-crust combination during winter 1996-97.

shear frame test as described by Jamieson and Johnston (in press). The strength is the ratio of maximum force to the area of the frame, which is then adjusted for size effects (Sommerfeld, 1980; Föhn, 1987) but not for normal load since Jamieson and Johnston (1998) did not find the normal load effect on weak layers of facets to be significant.

4. Observations

4.1 Formation

From 9 to 13 November 1996, 28 mm of rain and 16 cm of snow fell at Mt. Fidelity, and maximum temperatures were above freezing, forming a wet snow layer on the surface. From 14 to 17 November, 15 cm of dry snow fell with temperatures below freezing. From 18 to 23 November, 8 cm of snow fall and the maximum temperature ranged from –9.5°C to –17.0°C (average –13°C). Assuming the snow surface temperature was approximately equal to the air temperature and allowing settlement of 40% in the lower, warmer, dry layer over 4 to 9 days, the average temperature gradient in the dry snow would have exceeded 10° C/m (necessary for faceted crystals to form) while the wet layer released latent heat.

No snow fell on 24 and 25 November at Mt. Fidelity, but an average of 20 cm fell on 26 November at Mt. Fidelity and Mt. St. Anne (T_{MAX} –6.5°C) (Table 1), providing sufficient overburden for slab avalanches.

Table 2. Snowpack properties for slab, weak layer of facets and crust at Mt. St. Anne

Date	HS (cm)	H_{SLAB} (cm)	Load (kPa)	F	E (mm)	T_{WL} (°C)	TG (°C/m)	h_{WL}	Δh_{SUB}	S_{N38}
96-12-11	170	87	1.58	4c	1.5	-3.6	-8	2	3	1.2
96-12-14	172	89	1.58	4	1.5	-3.3	-7	2	3	1.5
96-12-20	178	109	2.10	4	1.5	-3.0	-6	2.7	2	1.1
97-01-10	230	161	4.27	4	2	-3.2	-4	3	2	0.9
97-01-18	225	163	4.47	4	1.5-2	-2.6	-4	3	2	0.7
97-01-27	252	180	5.47	4	2	-3.0	-3	3.7	1	0.7
97-02-04	265	205	6.31	4	2	-2.4	-3	3	2	0.8
97-02-11	257	192	6.36	4	2	-3.7	-3	2.7	1	0.5
97-02-19	283	217	6.83	4	1.5-2	-2.3	-3	3.7	1.3	1.1
97-02-25	272	210	6.66	4	2.5-3	-2.0	-2	3.3	1.7	1.1
97-03-04	312	243	8.32	4	1.5-2	-2.3	-4	3.7	1.3	0.9
97-03-13	318	258	7.43	4	2-2.5	-2.2	-5	3.3	1.7	1.3
97-03-21	302	261	8.93	4	1.5-2	-2.0	-1	3.3	1.7	1.2

A snow profile observed beside the Mt. Fidelity weather station on 1 December 1996 shows a 6-cm thick layer of facets (faceted crystals) overlying a frozen crust. The lower 2 cm of the faceted snow had a hardness of 4F (h = 2) and the crust had a hardness of P (h = 4).

By 11 December 1996 at Mt. St. Anne, the top of the crust was 87 cm below the surface. A 6-cm layer of facets (h = 2) was observed over the knife-hard crust (h = 5). On other profiles in the Columbia Mountains north of Mt. Fidelity, the crust was reported as knife-hard, probably because of more rain from 11 to 13 November 1996 than at Mt. Fidelity.

4.2 Weather

To give representative values for the North Columbia Mountains, T_{MIN}, T_{MAX}, and HN from Mt. St. Anne and Mt. Fidelity are averaged in Figure 2 for the period from 26 November 1996 to 31 March 1997. The North Columbia Mountains were influenced by arctic air from 21 to 28 December 1996 and 24 to 26 January 1997. During these periods there was little snowfall. Storms with consecutive days with HN > 10 cm occurred frequently throughout the winter but neither the snowfall amounts nor temperatures were unusual.

4.3 Snowpack

Manual snowpack measurements were made at the Mt. St. Anne Study plot on thirteen days over the 100-day period from 11 December 1996 to 21 March 1997 (Table 2). Except for the pronounced facet-crust combination, snowpack properties during the winter were not unusual. The height of snow on the ground reached over 300 cm by early March at Mt. St. Anne and Mt. Fidelity. The load increased from 1.58 kPa to almost 9 kPa. The temperature of the facets increased from –3.6 °C to –2.0°C while the magnitude of the temperature gradient decreased from 8°C/m to 1°C/m. In spite of these conditions which are generally favourable to rounding, the grain type F was reported as rounded facets (Class 4c according to Colbeck at al., 1990) on 11 December 1996 and as facets (Class 4) every day after that. Grain size E shows a slight increase over the winter from 1.5 mm to approximately 1.5 to 2 mm. The hardness of the weak layer increased from h = 2 (4F) to h = 3.3 (1F+). The difference in hardness was initially pronounced (Dh = 3) but decreased to 1.7 over the 100-day period.

Since snowpack variables were only measured 13 times between 11 December 1996 and 12 March 1997, daily values must be calculated so they can be correlated with daily avalanche activity. Daily values of load s_V and S_{N38} are calculated from field measurements taken approximately once per week and daily values of snowfall as described in Jamieson (1995). The calculation S_{N38} assumes that the shear strength of the weak layer increases linearly between measurement days. The other variables, which are expected to change monotonically and more slowly as the winter progresses, are calculated from a power law (Johnson and Jamieson, in preparation)

$$V/V_1 = (t/t_1)_A \qquad (1)$$

where V is the variable, t is time, V_1 is the fitted value of the variable at t_1 = 1 day and A is an empirical constant.

4.4 Avalanche activity

We used natural avalanches from six helicopter skiing operations in the North Columbia

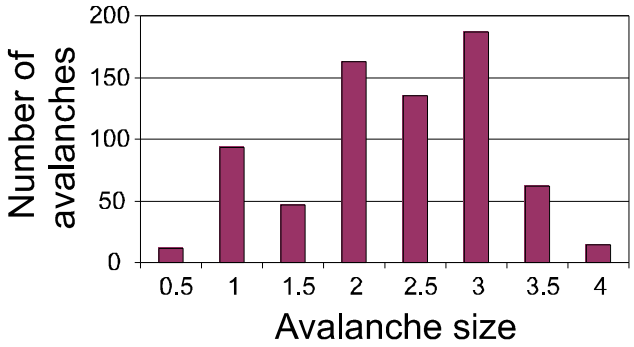

Figure 3. Distribution of dry slab avalanches by size for avalanches reported to have slid on November facet-crust combination in the North Columbia Mountains.

Mountains (Figure 1) in which the avalanche slid on the November crust, in the opinion of the guide who reported the avalanche. Since heliskiing guides do not ski or observe each valley in the area each day, the occurrence date of some avalanches was estimated. The avalanche "day" used by guides corresponds approximately to the 24-hour period used for the weather data in this study. To minimize the effect of inaccurate dating of natural avalanches we focus on days with many avalanches. When reporting more than two similar avalanches throughout the large forecast areas, guides sometimes report "few" or "numerous" avalanches, we translate these into 3 and 10, respectively, to estimate the number of avalanches with the specified characteristics.

The size classification of an avalanche is based on an estimate of its destructive potential (CAA, 1995) and ranges from 1 to 5. As avalanche size increases by one, the typical mass increases by a factor of 10. In our data, class 1 (small) natural avalanches are not consistently reported. However, we define a daily index of natural avalanche activity that weights larger avalanches

$$N10 = S\, N_i\, 10_{i-1} \qquad (2)$$

where N_i is the number of avalanches of size i reported, for avalanches of size 1 to 5. Half-sizes, e.g. 2.5, are rounded up to the nearest integer. The distribution of avalanches by size is shown in Figure 3 and the number of size 3 and 4 avalanches indicates the importance and destructive potential of these avalanches released by this facet-crust combination. Using the typical mass associated with the various size classes (McClung and Schaerer, 1993, p. 253), over 700 dry slab avalanches were reported on the November facets by 31 March 1997 with a total estimated mass of over 500 000 tonnes.

5. Results

5.1 Rank correlations

To assess the predictive merit of previous avalanche activity, we define S_MN10 as the sum of N10 over the previous M days. The measures of previous avalanche activity are correlated with N10 in Table 3. Due to the autocorrelations of these variables, the significance levels are not as good as estimated. The four correlations with the best significance levels are for the three previous days, indicating the persistence of avalanche activity on a particular layer over time.

Table 3. Rank correlations of previous natural avalanche activity with natural avalanche activity N10

Variable	Min.	Max.	Correlation	
			R	*p*
Σ_1N10	0	13300	0.40	4.E-06
Σ_2N10	0	13400	0.47	4.E-08
Σ_3N10	0	15370	0.47	3.E-08
Σ_4N10	0	17100	0.42	9.E-07
Σ_5N10	0	19710	0.42	7.E-07

Avalanche activity N10 is correlated with daily values of snowpack variables S_{N38}, s_V, Dh_{SUB} and T_{WL} in Table 4. All correlations are significant ($p < 0.01$). Physical interpretations of the correlations with T_{WL} and Dh_{SUB} are possible: Increasing T_{WL} favors bonding and strength gain for the facets. Also, the decrease in avalanche activity as Dh_{SUB} decreases may be due to a decreasing stress concentration where the stiffness changes at the facet-crust interface. However, T_{WL} and s_V may have little predictive merit for future deep slab instabilities. S_{N38} is more interesting; rather than increasing or decreasing monotonically, it varies through the winter and is negatively correlated with avalanche activity. Because this strength-load ratio has a physical interpretation, it may have predictive merit for other deep instabilities.

In Table 5, avalanche activity N10 is correlated with meteorological variables HST, T_{MIN}, T_{MAX} and changes in maximum and minimum air temperature over 1 to 5 days, D_MT_{MIN} or D_MT_{MAX}, as well

Table 4. Rank correlations of daily values of snowpack variables with natural avalanche activity N10

Variable	Min.	Max.	Correlation	
			R	*p*
S_{N38}	0.5	1.26	-0.19	3.E-02
σ_V (kPa)	0.81	9.55	-0.30	6.E-04
Δh_{SUB}	1.3	3.9	0.30	7.E-04
T_{WL} (°C)	-4.6	-2.2	-0.30	7.E-04

Table 5. Spearman rank correlations of daily meteorological variables with natural avalanche activity N10 over 126 days

Variable	Min.	Max.	Correlation	
			R	*p*
Σ_1HN (cm)	0	35	0.01	9.E-01
Σ_3HN (cm)	0	70	0.18	4.E-02
Σ_7HN (cm)	0	110	0.30	6.E-04
Σ_{11}HN (cm)	27	163	0.40	4.E-06
Σ_{13}HN (cm)	28	195	0.41	2.E-06
Σ_{15}HN (cm)	49	205	0.42	1.E-06
Σ_{17}HN (cm)	64	229	0.33	1.E-04
HST (cm)	0	168	0.14	1.E-01
T_{MAX} (°C)	-25	2	0.05	6.E-01
Δ_1T_{MAX} (°C)	-8	16	0.03	7.E-01
Δ_2T_{MAX} (°C)	-12	22	0.11	2.E-01
Δ_3T_{MAX} (°C)	-16	24	0.17	6.E-02
Δ_4T_{MAX} (°C)	-18	23	0.22	1.E-02
Δ_5T_{MAX} (°C)	-19	23	0.18	4.E-02
T_{MIN} (°C)	-31	-2	0.10	3.E-01
Δ_1T_{MIN} (°C)	-12	18	-0.03	7.E-01
Δ_2T_{MIN} (°C)	-17	23	0.06	5.E-01
Δ_3T_{MIN} (°C)	-19	27	0.12	2.E-01
Δ_4T_{MIN} (°C)	-22	27	0.17	5.E-02
Δ_5T_{MIN} (°C)	-24	27	0.14	1.E-01

as accumulated snow fall over periods up to 19 days. For the accumulated snowfall S_MHN, the most significant correlation is obtained over 15 days. This correlation is influenced by the 12-day period with little snowfall from 17 to 28 December and the three following days with substantial snowfall before N10 increased. It is likely that the correlations over such long periods are statistical rather than physical relationships and lack predictive merit for other deep instabilities. Nevertheless, the positive correlations for period of 3 days and longer are better than for HST indicating that a single day without snowfall may not effectively interrupt the response of a deep weak layer to increased load.

T_{MIN} and T_{MAX} are not significantly correlated with avalanche activity. The most significant correlations for temperature change are over four and five days for T_{MAX} and T_{MIN}, respectively, suggesting that multi-day temperature changes may affect the stability of deep slabs. These correlations are positive, associating increased avalanche activity with warming.

5.2 Deep slab avalanches with little recent snowfall

During the winter, forecasters reported many large spontaneous avalanches with little or no recent snowfall. There were 32 days for which S_1HN < 5 cm and S_3HN < 10 cm, which corresponds to increases in slab load of less than 1% per day after s_v reached 4 kPa on 4 January 1997. On 24 of these days no avalanches were reported to have occurred. On 26 December 1996 only one class 3 avalanche (N10 = 100) was reported. On the remaining seven days, N10 exceeded 100 indicating multiple avalanches or a class 4 avalanche. On 14 January and 24 February 1997, the wind speed was above critical level for nine or more hours so the avalanches on these days may have been caused by wind blown snow increasing the load in avalanche start zones. The other six days exemplify the challenge faced by avalanche forecasters during the winter. With little or no recent snowfall or wind loading, large avalanche occurred spontaneously.

Such avalanches are often attributed to changes in air temperature or snow surface temperature. However, the temperature changes would not have been conducted down to the faceted layer anywhere with average snowpack properties since the average thickness of the avalanches in this study exceed 120 cm (perpendicular to a 38° slope) by 10 January 1997. McClung and Schaerer (1993, p. 82) explain that warming can release thin slabs by reducing the stiffness of a significant fraction of slab depth. We hypothesize that the temperature effect must be coupled with a start zone where the slab thickness is highly variable. One of the forecasters, B. Howatt (personal communication, 1997), confronted with this difficult series of avalanches, reported that by mid-winter only start zones with a relatively thin snowpack or rocky outcrops were producing avalanches, a statement which supports our hypothesis. Also, the layer of faceted crystals or depth hoar may be more developed and weaker near rock outcrops (Logan, 1993), favouring avalanche initiation.

Three large deep slab avalanches occurred on 26 January 1997 after five days of marked cooling. Seligman (1936, p. 324) hypothesized that cooling of the surface could cause sufficient contraction and related stresses to trigger avalanches; however, no theory has yet been developed to support this hypothesis. Further, any theory must take into account the stress dissipation of snow.

6. Summary

During the winter of 1996-97, deep slab avalanches starting on the November facets were associated with avalanche activity over the previous two or three days, accumulated snowfall over

periods of three or more days, increasing air temperature over four to five days, the presence of a marked hardness difference between the facet layer and the underlying crust, strength tests of the weak layer that result in planar fractures, and low values of the shear frame stability index S_{N38}. The accumulations of snowfall that was reset to zero by 24-hour periods without precipitation was not as promising as accumulated snowfall over three or more days.

Given a widespread meteorological condition that forms a layer of facets on a crust, snowpack characteristics observed in a study plot can be useful predictors of avalanche activity over time within the area of the formative weather. While we did not consider roving snowpack observations at sites that vary from day to day, such observations at carefully chosen sites may be able to identify key snowpack characteristics and their variation over terrain.

Warming over four to five days may reduce the stability of deep slabs, especially where the snowpack is locally thin or has rocky outcrops. Experienced forecasters report occasional unexpected avalanches during periods of cooling with little or no precipitation. Research into the effect of rapid cooling on the stability of deep slabs may prove valuable.

The stability of start zones where snowpack properties are highly variable may be less stable, unstable for longer periods and more difficult to predict. Because of this spatial variability, remote meteorological and snowpack measurements, by themselves, will not be adequate for forecasting avalanches in specific start zones.

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CAA MEMBERSHIP SURVEY 2000 RESULTS
General

How many years have you been a Member?	Total Responses	Percentage of Response
first year	21	**19%**
2-5 years	35	**32%**
6 to 10 years	24	**22%**
over 10 years	32	**29%**
What type of Membership do you now hold with the CAA?		
Professional	68	**61%**
Affiliate	25	**23%**
Associate	17	**15%**
My primary Employment is:		
Government	31	**28%**
Large corporation 100 employees	29	**26%**
Self employed	26	**23%**
Small business and/or Owner operated	24	**22%**
Mid Size corporation over 10 under 100 employees	12	**11%**
Why are you a Member of the CAA ?		
Education	89	**80%**
Individual growth	74	**67%**
Recognition	39	**35%**
Improved income opportunity	29	**26%**
Community involvement	20	**18%**
Volunteerism	9	**8%**
Don't know	5	**5%**
Other		
What does the CAA most importantly represent to you?		
Professionalism	93	**84%**
information exchange	91	**82%**
Public safety	90	**81%**
Networking	54	**49%**
Community	22	**20%**
Other		

Note: Total number of participants in the membership survey was 111

Up to 3 selections could be made in the following categories

CAA MEMBERSHIP SURVEY 2000 RESULTS
General con't

What more could the CAA do to benefit you?	Total Responses	Percentage of Response
More training courses	59	**53%**
More industry news	53	**48%**
More member communication	34	**31%**
More government lobbies	15	**14%**
More social activities	4	**4%**
Other		
If you ran the Association you would		
concentrate on maintaining present course	54	**49%**
concentrate on improving member services	39	**35%**
concentrate on Public Initiatives	37	**33%**
concentrate on member Initiatives	31	**28%**
concentrate on money issues	20	**18%**
concentrate on changing government policy	14	**13%**
Other		
The focus of the Spring AGM should be		
learning new technology	87	**78%**
planning for the future	86	**77%**
networking	75	**68%**
reviewing the past	48	**43%**
having fun	37	**33%**
Other		

Note: Total number of participants in the membership survey was 111
Up to 3 selections could be made in the following categories

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CAA MEMBERSHIP SURVEY 2000 RESULTS
Membership/Training/Volunteerism/CAA Relationships/AGM

MEMBERSHIP	Total responding yes	% yes
Do you read the newsletter?	**107**	96%
Would you read an electronic newsletter?	**107**	96%
Would you say that being a member of the CAA has been positive for you?	**98**	88%
Would you be willing to have this info released to the general membership about yourself?	**94**	85%
Would you like to receive a membership list including names, addresses, phone numbers, places of employment?	**88**	79%
Do you think that professional members of the CAA should be recognized by the public by a special crest?	**71**	64%
Would you support the CAA communicating more with your employer?	**58**	52%
Should the CAA expand its membership to include foreign avalanche Professionals?	**57**	51%
Would you support an increase in dues for your membership if you received more services?	**50**	45%
Would you participate in a membership drive for the CAA?	**49**	44%
Is your employer an Associate member?	**49**	44%
Do you feel that we need a professionals only newsletter?	**17**	15%
TRAINING		
Would you attend an Explosives Avalanche Control course?	**78**	70%
Would you attend a multi day Advanced Forecasting course?	**74**	67%
Would you participate in an on-line course?	**69**	62%
Would you attend an Advanced Avalanche Rescue course?	**64**	58%
Would you attend a Hazard-mapping course?	**63**	57%
Would you attend a Computer-oriented course?	**55**	50%
Would you attend a Media course?	**54**	49%

Note: Total number of participants in the membership survey was 111

CAA MEMBERSHIP SURVEY 2000 RESULTS
Membership/Training/Volunteerism/CAA Relationships/AGM con't

VOLUNTEERISM	Total Responding yes	% yes
Would you serve on a current committee or board?	**64**	58%
Would you participate as a volunteer in the public service initiatives of the CAA?	**63**	57%
Would you provide articles for the newsletter?	**61**	55%
Would you attend an organized PEP rescue as a volunteer?	**54**	49%
CAA RELATIONSHIPS		
Would you support the CAA's ongoing partnership with various private organizations?	**104**	94%
Would you support the CAA's ongoing partnership with international agencies?	**104**	94%
Would you support the CAA's ongoing partnership with various government organizations?	**102**	92%
Should we investigate getting group long-term disability insurance	**48**	43%
Should we investigate getting group life insurance	**45**	41%
Should we investigate getting group dental plans	**34**	31%
AGM		
Are you generally satisfied with the location of the AGM?	**74**	67%
Would you encourage others to attend the AGM?	**70**	63%
Do you attend the AGM?	**69**	62%
Would you encourage your employer to attend the AGM?	**46**	41%
Would you participate in the planning of an AGM?	**35**	32%

Note: Total number of participants in the membership survey was 111

CAA MEMBERSHIP SURVEY 2000 RESULTS
Project Rating

SURVEY RESULTS FOR ASSOCIATION ACTIVITIES

QUESTION	Rating in Percent	Rating in Percent	Rating in Percent	Rating System (Total Participants 111)					
	1 & 2	3	4 & 5	1	2	3	4	5	No Response
Spring Meeting AGM	8%	**49%**	43%		6	40	32	3	30
Newsletter	17%	**51%**	32%		18	53	30	3	7
Member Services	19%	31%	**50%**	2	18	33	42	11	5
Web Services	9%	35%	**56%**	1	8	33	42	11	16
International Representation	23%	**44%**	33%		15	28	18	3	47
CPD presentations/lectures	18%	**43%**	39%	1	13	33	21	9	34
Communication with Volunteer Committees	20%	**55%**	25%		10	28	13		60
Communication with RAC Providers	17%	**53%**	30%	2	8	31	16	2	52
Communication with Professional Members	13%	**59%**	28%	1	9	47	18	4	32
Communication with Peer Groups	34%	**50%**	16%	2	18	29	7	2	53
Communication with Partners	5%	**71%**	24%		2	29	8	2	70

Follow these guidelines for pages 38 through 40.

NOTE: The percentage is taken from the total replies to the question, not the total participants

1- Unacceptable — Changes required immediately
2- Substandard — Changes required in time
3- Status quo OK — No changes required
4- Above standard — Performance has added value
5- Outstanding — Performance has exceeded expectations

SURVEY RESULTS FOR CAATS

QUESTION	Rating in Percent	Rating in Percent	Rating in Percent	Rating System (Total Participants 111)					
	1 & 2	3	4 & 5	1	2	3	4	5	No Response
Program development	21%	27%	**52%**	2	11	17	27	6	48
Appropriateness of training for industry needs	28%	26%	**46%**	2	16	17	25	5	46
Appropriateness of training for skill development	17%	29%	**54%**	1	11	20	28	10	41
Course scheduling	3%	**56%**	41%	1	1	36	21	5	47
Course content	14%	30%	**56%**	1	8	19	29	7	47
Course delivery	3%	29%	**68%**	2		19	33	12	45
Course cost	14%	**57%**	29%	1	8	38	15	4	45
Course relevance	16%	27%	**57%**	2	9	18	29	10	43
Course locations	6%	45%	**49%**	1	3	30	27	6	44
Communication with volunteer committees	18%	**56%**	26%		6	19	8	1	77
Communication with Professional members	15%	**60%**	25%	2	5	29	10	2	63
Communication with peer groups	20%	**68%**	12%	1	6	23	2	2	77
Communication with partners	6%	**71%**	23%		2	22	5	2	80

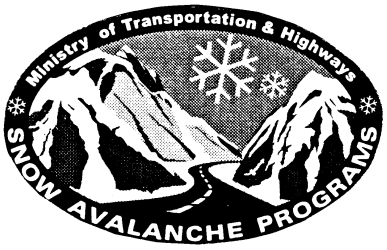
SURVEY RESULTS FOR INFOEX

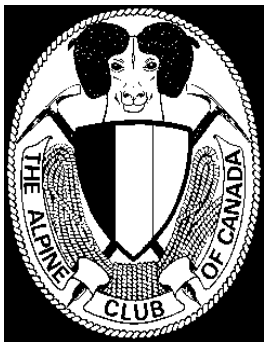
QUESTION	Rating in Percent	Rating in Percent	Rating in Percent	Rating System (Total Participants 111)					
	1 & 2	3	4 & 5	1	2	3	4	5	No Response
Program development to keep pace with industry changes	5%	42%	**53%**		3	27	25	9	47
Hardware upgrades	11%	**64%**	25%	1	4	29	10	1	66
Security	9%	**63%**	28%		4	29	12	1	65
Timeliness		41%	**59%**			26	26	12	47
Reliability	3%	31%	**66%**		2	20	26	16	47
Equality of service among subscribers	10%	**47%**	43%	5		25	17	6	58
Enforcement of contract	11%	**63%**	26%		4	22	8	1	76
Affordability	22%	**42%**	36%	6	5	21	14	4	61

SURVEY RESULTS FOR PUBLIC SAFETY

QUESTION	Rating in Percent	Rating in Percent	Rating in Percent	Rating System (Total Participants 111)					
	1 & 2	3	4 & 5	1	2	3	4	5	No Response
Public Bulletin Content	8%	35%	**57%**	1	6	31	40	10	23
Public Bulletin accuracy	11%	35%	**54%**	1	8	29	37	8	28
Public Bulletin timeliness	30%	**42%**	28%	2	23	35	20	4	27
Public Bulletin distribution	1%	45%	**54%**		1	36	36	8	30
Public Bulletin appearance	5%	40%	**55%**		4	35	38	10	24
Public Bulletin delivery methods	6%	36%	**58%**		5	30	37	12	27

OUR KEY SPONSORS





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